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THE

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UNITS—RATIONAL *v.* IRRATIONAL.

"Age cannot wither, nor can custom stale
Thine infinite variety."

WE have been vastly entertained and amused—we cannot conscientiously say instructed or edified—by the perusal of a leading article which appeared the week before last in a prominent contemporary technical journal. In this article the writer falls foul of that redoubtable knight Professor John Perry, and runs a tilt with him about the perennial and evergreen question, "What is the best system of units?"

The circumstances are briefly as follows:—In the issue of *Nature*, of September 24th, Prof. Perry, in reviewing the latest edition of Dr. Everett's well-known work on "Units and Physical Constants," takes occasion to state very plainly in some places, though rather obscurely in others, his views regarding units in general; and in particular, contrasts those used by mechanical and by electrical engineers, to the manifest confusion of the former. Several times the righteous soul of the Professor waxes sore within him, and prompts him to indulge in language that comes very near what the Scotch call "swearin' at lairge" at those who, with perverse ingenuity, get out of a difficulty by making units to suit their case. Once only does Prof. Perry reveal his nationality—this merely in passing—by a bull, whose flavour is all the richer because it is not evident at the first glance; and that is where he says that "the mechanical engineer is accustomed to the *use* of a curious unscientific *want of system* in his calculations!" The views expounded in the review are to the effect that a decimal system of units in general, and the C.G.S. system, where all the magnitudes are referred to certain fixed natural magnitudes, in particular, is much to be preferred to the cumbrous systems of weights and measures, at present taught in our schools and colleges, because in common use throughout the length and breadth of the land. "The labours of many men," says Prof. Perry, "have given to the present generation this beautiful system (the C.G.S. system) of units, which has made physical calculation so easy, and which has pointed out in certain cases the directions in which new discoveries might be expected. And it only requires a short study of certain parts of this book to put any student in such possession of the system that he can use it with certainty and ease." While we cannot, in the laconic phrase of the renowned "Single-speech Hamilton," chime in with "Ditto to Mr. Perry" to all that the review contains, we are most assuredly at one with him in his general contention that the C.G.S. or some other similar system is infinitely better as a mode of expression and calculation, than our present utterly irrational ones, which possess neither beauty nor adaptability, and which abound in pitfalls. And we should never have expected to find in this latter half of the nineteenth century any sensible, thinking man who, whatever he is compelled by the inexorable force of surrounding circum-

stances to practice, in his inmost soul held any other opinion. And yet here we have a veritable Rip van Winkle of a writer in the leading columns of the aforesaid prominent contemporary technical journal, taking Prof. Perry to task about these views of his, describing him somewhat contemptuously as an "engineer become a schoolmaster," and flouting at the system he advocates as being utterly useless for practical men. With a courage which would have met with greater admiration had it been displayed in a worthier cause, this modern Don Quixote mounted on a sorry hack, with spurs and weapons blunt and rusty, rushes to do battle in defence of a set of units and standards which ought to have been obsolete generations ago. Like his Spanish prototype, too, he sees a windmill, which he mistakes for his antagonist, and proceeds to attack it with might and main. This, however, is just as it ought to be; for assuredly his weapons are of much more service in demolishing windmills than in fighting with a man like Prof. Perry.

Imitating the guardedness of the writer of the article, we would remark that we do not intend to criticise what he has said about Prof. Perry; but he has had something to say about systems of units and modes of expression which we cannot pass without comment.

Here are his opening sentences: "When an engineer undertakes to teach engineering classes, and ceases to work as an engineer himself, the chances are a hundred to one that he will adopt methods *(sic!)* and modes of thought which he would not have used while practising his profession. The reason for this is not very obvious"! Well, now, we should have imagined that the reason was the very, *very* obvious one, that, finding the new mode so much better, he discards the old in its favour the instant that he makes the discovery.

It is worthy of note that the engineer, turned professor, is not teaching some new thing; he is merely trying now to instil into the minds of younger men that which he knows and formerly practised. To do this with the smallest labour to himself and with the greatest ease and certainty to his pupils, he finds that, in his teaching, he must adopt the simplest vehicles of expression and calculation. If he does not at once find anything simpler than those which it has been his habit hitherto to use, he goes on using them until he does—and not one moment longer. It will readily be admitted that what is easiest taught is easiest learnt; and what is easiest learnt is easiest practised; and so the professor tries to make things as easy for all concerned as possible. This, surely, is merely rational. But where the difficulty of the engineer-professor comes in is here—that whereas he teaches the simple and rational modes from choice, he has also to educate his students according to those complex, stupid and irrational systems in use outside the schools, in order that his students may derive real benefit from his teaching and be able to earn a living.

Then the writer goes on: "Possibly the engineer become a schoolmaster finds that the intuitions and inspirations which guided and served him in his daily work cannot possibly be transferred to the minds of his pupils." Well, we never yet knew anyone who gained a knowledge of those physical abortions called "Tables of Weights and Measures" and who learned to calculate deftly and accurately by their help, by "intuition and inspiration." And as to their not being capable of transference to the minds of the pupils, they are capable of being so transferred; but the grudging thing is that they *have to be* transferred, when there is no more reason for such a necessity than there is (to paraphrase Prof. Perry) for a man to swim the Hellespont when he might cross comfortably in a steamer.

Furthermore, we have the same writer expressing himself: "A tendency grows up, and, if left unchecked, flourishes exceedingly, to believe that what is good for teaching young men, must be also good for those who are already as far past the pupil stage of existence as it is possible for any wise man to get." Now we wonder if this writer ever heard of those good old proverbs, one of which talks about what is good for the child not being bad for the nurse, and the other refers to sauce which may be used equally with goose and with gander. Or does he expect us to believe that methods which a boy in school finds easiest to learn and to use, *and which are easily applicable in all possible cases that might arise whether in theory or in practice*, are quite unsuited to his requirements after he leaves school or college; that, now he has arrived at man's estate, he must "put away childish things;" that, in short he ought now to adopt methods which are as much to be condemned for their difficulty as the others are to be commended for their simplicity? The idea is manifestly absurd. In connection with the above quotation the interesting question arises, "When ought a man to consider himself past the pupil stage of existence?" Some one older than ourselves must answer this question, for we are not yet (in spite of sundry gray hairs which we do our best to ignore and conceal) "past the *pupil* stage"—in the broad sense of the word.

But we do not propose to argue further with the writer of this article; indeed, argument is to a great extent thrown away on one who describes Professor Perry as a "man who thinks the ridiculous little dynes and centimetres superior to pounds and inches." Such an expression shows at once as little knowledge of the merits of a good sensible decimal system, as it does indifference to the demerits of the systems of calculation now in general use. Such men as this are to be found in plenty amongst the crofters and small farmers of these islands, who stubbornly refuse to introduce any improvements in their methods, with the remark that "what was good enough for their fathers and grandfathers is surely good enough for them." This is the very essence of good old crusted Toryism of the most pronounced colour! We can well believe that this was the type of man who wrote and spoke vehemently against the introduction of railways, on the ground that there would be no longer any need for horses, and that the breed would decay and soon die out altogether; who painted harrowing pictures of blazing cornfields, farmsteads in ashes, and whole towns in jeopardy from the sparks of the locomotive; who prophesied a future of woe and desolation.

Passing from this, however, we are strongly inclined to agree with Prof. Perry that "the difficulties in the way of reform seem to be insurmountable." So great, indeed, do the difficulties seem to be, that we are tempted to exclaim with the prophet, "Ephraim is joined to idols: let him alone;" and we fancy we can hear Ephraim, in the person of the writer of the article which we have been considering, giving back the reply, "Yes, go your own ways, use your own methods, and let us alone; our idols are good enough for us." At the same time, we cannot help thinking that many

of the difficulties would disappear if the class distinctions which unhappily exist amongst all sections of the community, and which are sedulously fostered by men like the writer of this article, could be broken down. If all scientific men, whether working in the domain of natural or of applied science—chemists, engineers, electricians, physicists, call them by whatever name you will—fully realize that they have one common end in view, viz., the investigation and application of nature's laws for the benefit of all mankind, then the first and greatest difficulty will disappear. Men would then approach the minor subject of systems of units and modes of expression, with minds open to acknowledge the truth and eager to adopt the simplest method of arriving at and of imparting it. And, in our experience, we find the pride of class nowhere so strong and so unreasoning as it is with your so-called practical man ; but it is the pride of sheer ignorance. Not ignorance of his own methods and systems—we give him free and hearty credit for all cleverness, shrewdness, and ability within his own domain—but ignorance of other systems, a short study of which would convince him were very much better.

We are averse, however, thus to narrow the subject, and confine the issue to a single combat between the practical engineer and the physicist ; for all classes of the community are handicapped in the struggle for existence by our present absurd systems. The shopkeeper, the merchant and the banker, alike feel the irksome despotism of this old man of the sea, who clogs their movements and hampers their footsteps. There would be no longer need for a tithe of the ready-reckoners or cumbersome "tables," if we in this country would open our eyes to the irrationality of our present systems of working. A good decimal system could be learnt in one-fifth of the time, and applied with much less risk of error in one-fifth of the time, that it takes to learn and apply the many systems—all equally bad—which we now use. There would thus be saved much time, trouble, and temper, which would materially add to our health, happiness and prosperity.

There are only two things, as far as we can see, which would effectually bring about this much-to-be-desired end. The first is a Revolution. "They manage these things better in France," is a common, if not a universally believed saying ; and certainly they managed this matter much better at any rate. Something like a century ago, the French people arose in their might to revolutionize everything. One result was their monumental Metric System, which is at once so rational, and so simple, that one does not feel oneself working at all—the thing seems to work itself. We are only sorry that they did not give us a decimal table of time when they were at it.

The second thing that will bring this about is a strong healthy Public Opinion ; and doubtless this method will commend itself to our peace-loving people much more readily than the other. We are quite at a loss to find any cogent reason why, in these democratic days when all class distinctions are rapidly disappearing, this one ought to be allowed to persist ; or why, when race distinctions are being certainly lost sight of in the face of international exhibitions, congresses, and communications of all kinds, we should not gladly promote an international system of calculation, based on the only rational one, the decimal system. Such a consummation is devoutly to be wished for, and is, we venture to think, bound to come sooner or later. Is it too much to think that it is nigh at hand ? If so, then we can only with Burns,

> " . . . . pray that come it may,
> As come it will, for a' that ;
> . . . . . .
> When man to man, the warld o'er,
> Shall brithers be for a' that,"

in this as in every essential respect.

POSSIBILITIES OF APPLIED SCIENCE.

With the true spirit of prophecy, Mr. Oberlin Smith, in a paper read before the Franklin Institute, informs us of those things which should ultimately come to pass. Roughly speaking, he divides his foreshadowings into three factors : possibilities, probabilities, and certainties of which there is no probable, possible shadow of doubt whatever. The subsubjects have reference to food, clothing, shelter, warmth, light, trade, travel, learning, art and health. At the outset Mr. Smith regrets that photography is, at present, insufficiently developed to illustrate the future, so that, in the absence of lantern slides, his audience were dependent upon mental transparencies drawn from his prophetic imagination.

We are, indeed, sorry we cannot honour the prophet, even in this country, with the credit of possessing originality. In the commonplace *present*, of course, it takes a considerable time for ideas to get from England to Philadelphia ; and this may, in part, account for the fact that some of his probabilities are already numbered amongst our actualities. From the early prophecies we give the following probability in illustration of our point :—

"Undoubtedly," he remarks, "some better way will be contrived to fit garments to the human body than the crude methods now in use, of cutting up whole pieces of cloth at the expense of considerable waste, into irregular shaped sections which must be again sewed together. Very possibly the future may develop automatic methods of weaving or knitting fabrics to the exact shape required, so that they will be entirely seamless." Mr. Smith has modestly closed his eyes to those subtle *combinations* of the weaver's art with scientific method, applied to woollen, worsted, silk and Jaeger.

Of aluminium, telephony, electric lighting, electric railroading, electric power transmission, electric welding and electric reduction of metals, the prophet prophecies much : but so does everybody else. Indeed, we plead guilty of having expressed these sentiments ourselves for some time past.

The hypothetical electric ship, and the hypothetical electric bird are next brought upon the horizon. The ship is to have a sufficient number of air cells to make it absolutely safe ; and the flying contrivance is to dispense with gas bags altogether, as dangerous ; Mr. Smith remarks, "a lark couldn't fly carrying an inflated pillow case."

There is running throughout the paper the great idea of "standardisation" of manufactured articles, both in regard to quality and material, in design and in dimensions. Another development of this same thought is with respect to the standardising of language, "not only in different provinces of a country where a given language is spoken, but throughout different eras of time." But surely the principle of standardisation is directly opposed to the spirit

of progression; and where would the spirit of prophecy come in, with its hypothetical boats and birds?

Have rational weights and measures by all means, but do not standardise manufactured goods just yet. Again, if language and scientific terms were standardised, it is doubtful whether philologists would permit our prophetic cousin such luxuries as "skeptical," "pure-energy," "pure-light," &c. Evolution applies all round,—to the possibilities of science as well as to the organisms of Nature. But the future lies outside the circle of science. The possibilities of science are simply infinite, and it seems idle to dream about them, for, after all, *it is the unexpected that happens.*

HIGH-PRESSURE ELECTRICAL DISTRIBUTION.

A WRITER in *Nature*, reviewing the progress made in the art of electrical distribution by high-pressure alternating currents and transformers, and looking to the results achieved in and around London, especially at Deptford, concludes that long-distance transmission by these means is commercially, a "dreary failure." Various reasons are given for supporting this conclusion; principally these are based on the loss of power alleged to occur in transforming the pressures first *up* to 10,000 volts at Deptford and then twice *down* to the consumers in London, and also to the great expenditure of capital which has been found necessary, having an eye to a large supply in the future, while neglecting the more pressing needs of the present, demands. Such criticisms are, perhaps, premature. The Deptford installation has been planned and carried out in every detail under very exceptional circumstances. There was absolutely no experience to draw upon in constructing and installing plant for the generation and distribution of alternating currents at 10,000 volts pressure, and the scheme altogether was planned on a very gigantic scale, so that the expenditure of time and money has been necessarily on the same scale.

The questions to be decided by the results of the working of the Deptford installation are most likely to be as to whether 10,000 volts is too high a pressure for practical use; whether the saving in copper in the mains is not far more than overbalanced by the increased cost of insulation throughout the plant. There must be a pressure at which we can work, where the saving in copper is such that it makes it worth while to work with alternating currents at high pressure. At that pressure the insulation cost must not be much higher than that for ordinary three-wire 200 volt working.

High pressure saves the copper in the mains only, but it *adds* to the cost of insulation all over—in dynamos, mains, and transformers.

Another question is whether the generators should be of the large sizes proposed, or should be divided into numerous small units. At Deptford very large dynamos are to be used, if the scheme is carried out in its entirety. Most practical engineers incline to the use of small units, independent of each other, a practice universally carried out in American generating stations. It would seem from the fact that the 10,000 volts sent from the Deptford station is got up by a transformer, that large dynamos present difficulties in the way of generating such a high pressure directly. This system, using low-pressure alternators and transforming up to high pressure, is one which has many advantages at other places as well as at Deptford. At generating stations in cities or towns the low-pressure alternating currents can be distributed directly from the dynamos all around the immediate vicinity of the station without transformation, while for distant consumers it can be passed through a transformer transforming up to any voltage.

There can be little doubt of the wisdom of placing a large generating station outside of a large town altogether. Land is less costly, coal, as a rule, much cheaper, and the coal, it must be borne in mind, is the raw material out of which the article to be sold is manufactured at a generating station, especially if carried to the door by water, and condensing water, if got for nothing, is also a consideration. Where engines of thousands of horse-power are to be run these savings would certainly repay the extra outlay on a few miles of mains. A large generating station in a city has some objectionable features, smoke, steam, dirt and noise; coals for thousands of horse-power, water for same, and the removal of ashes, have all to be considered in fixing upon a site for a large generating station. These points seem to have been thought over in fixing the plant at Deptford. The ultimate triumph of the alternating current distribution depends chiefly on its flexibility, and on its being rendered available for power and storage; with these and its easy transformation it must succeed.

Time must elapse, yet, before any decided conclusions in this direction can be drawn from the working of the Deptford scheme.

Meanwhile improvements are constantly being made by many inventors in nearly every detail; these all tend to the perfection of the art. Many of them cheapen the first cost of the plant, and effect economies in distribution, so that it would seem bad policy on the part of electrical supply companies to go in on a large scale for future contingencies; with sufficient plant for present needs, these improvements can be secured in any additional plant required as the consumers increase in numbers.

In the near future the incandescent lamp will be made and sold by many firms and much cheapened in price; the electric light business will receive an enormous impetus, and then large stations like Deptford may show up the possibilities in the way of generation and distribution at very high pressures.

The high-pressure transmission between Lauffen and Frankfort at 20,000 volts is quite another problem solved, not a distribution over a town or city. It only proves the perfection to which insulation on pole lines of wire can be brought up to. Neither does the perfection of the polyphasal alternating motors mean much increase of consumers on the presently existing alternating current generating stations, where, as a rule, only one current of one phase is supplied.

The Pathology of Lightning Strokes.

A STROKE of lightning always produces symptoms of paralysis in the subject affected, and according to a well known German physician, Dr. von Limbeck, all cases of paralysis from lightning may be separated into two classes:—(1) Direct paralysis (2) indirect paralysis. In other words, the symptoms of true paralysis are separated by this authority into those which are due to the direct action and those which are due to wounds of the nerves. Speaking before the German Association of Physicians on this subject recently, the doctor said that the paralysis of the nerves produced by a stroke of lightning ceases much sooner than does the paralysis of the muscles, because the effect of the stroke is greater on the functional energy of the muscles than on that of the nerves. Statements of this kind which apply to strokes of lightning we presume may be held to apply also to strong electric shocks.

THE PROGRESS IN THE ART OF MODERN INCANDESCENT LIGHTING.*

By Dr. L. K. BOHM.

(*Concluded from page* 424.)

For some years there was not an invention on the lamp which did more than to perfect details or appliances appertaining to the lamp until the structureless filament came. We have seen that the filaments described so far were made of fibrous vegetable material. They possess, after carbonising, the cellular structure of the plant of which the filament was formed, consequently they are very porous before they are treated. (Fig. 9.) The material for structureless filaments

Fig. 9.

is not prepared by nature as the vegetable fibres are; it is a laboratory product. First, a putty-like mass of collodion or gelatine is prepared. This mass is rolled out in thin sheets like paper, which are cut in narrow thin strips and the strips are carbonised. The mass may, by employing a little heat, be spun out into fine threads, which are carbonised. Filaments made of such materials are more uniform throughout than fibrous filaments; they are very hard, and as they have no cellular structure like the fibrous filaments they are not porous, consequently they are more homogeneous, and in every way far superior to the fibrous filaments. As soon as the advantages, as well as the methods of manufacturing these structureless filaments are generally known, then the fibrous high resistance filament will be a thing of the historical past. Only high resistance filaments are made of such masses. They are just as much limited as to voltage as bamboo is. A series lamp cannot be made of either. The exact components of such collodion or gelatine masses are not known, as they are kept factory secrets. The principal manufacturers of structureless filaments are Siemens and Halske, in Berlin, and the De Khotinsky Company, in Gellnhausen, near Frankfort-on-the-Main. They are made in this country by various companies, the Germania Company, of Boston; the Economic Company, of Boston; the Thwing Company, Chicago; the Buckeye Company, Cleveland, &c. There have been filaments before, which could be called structureless. Edison describes a plastic mass of lampblack and tar, which was rolled out in threads and carbonised, and it may be wise to point out the difference between the two. The modern structureless filament does not contain a particle of carbon when it is put into the carbonising furnace; the collodion or gelatine is transformed into carbon in the furnace, while a filament of lampblack and tar contains nothing but carbon in the form of carbon powder and a "binder" before it enters the furnace. It is baked only to cement the carbon powder together. The filament of lampblack and tar has never been a practical success, while the modern structureless filament is a great commercial success. Very recently, in 1891, novel processes of treating filaments have been patented by F. G. A. Heller and George Erlewein, of Berlin. By their treatment the filaments are coated with mineral substances, such as chromium, phosphides, iron, &c. Reports about the practical success of these lamps have not yet been published.

We have so far shortly reviewed those inventions which constituted really a step in the progress of the art of the incandescent lamp, and now we will draw conclusions, describing inventions a little more in detail only when it is absolutely necessary. Inventors of appliances pertaining to the lamp will kindly take notice that only the *lamp* is spoken of, and that even the socket is not considered. The various fibrous materials of which filaments are made are not mentioned, because it is all the same in principle whether a fibrous filament is made of cotton or linen thread or silk, of paper, bamboo, India fibre or Piassawa, of Kittul, southern moss, basswood or palmetto, of Mexican hemp, jute, cocoanut, palm, or manilla; they are all fibrous vegetable materials.

When we look back at the progress in the art up to the appearance of the commercial lamp we find, as stated, that most of the elements of the lamp were known and used for various purposes. There was the all-glass closed chamber with leading-in platinum wires hermetically sealed; there was a luminous bridge of rarefied gases; carbon had been used in vacuo as an incandescent conductor; there were high resistance filaments of platinum for parallel distribution and high vacua were employed before. What patentable features remained to be invented? On what elements could patents be obtained? It looks as if patents could be obtained only on special incandescent conductors and processes for making them, on devices for clamping or fastening filaments to the wires; in fact, it looks as if patents, for special processes and mechanical details only, could be obtained, but that is not so. The United States Government, protecting the inventor, very wisely grants a patent for a combination. It is well known that neither all nor any of the elements or parts of an apparatus or machine need to be novel. If by their combination a new or useful result is achieved, then the combination is novel and as such patentable. Mr. Edison invented a high-resistance filament of fibrous material; he had it enclosed in an all-glass chamber, and he was granted a patent for the invention, January 27th, 1880. The first two claims of this patent read as follows:—

1. *Claim.*—"An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires, as set forth."

Can any one concern or company on the strength of this claim control the manufacture of incandescent lamps with high-resistance filaments? Certainly not! In the first place, high-resistance filaments of other material, of platinum, were used before. Lane-Fox had three patents granted to him, two in October, 1878, and one in March, 1879. This fact is further conceded by highest authority. Judge Wallace, in his decision of July 14th, 1891, says, "Electricians knew how to make conductors of high resistance," &c. Can anyone on the strength of this claim control the manufacture of incandescent lamps with high-resistance carbon filaments? Certainly not! The limits of Edison's invention are shown very clearly by this very first claim of his patent, for only "a filament of carbon of high resistance, 'made as described,'" is claimed, and in order to see what special kind of filament is protected by that claim, we have to study the description of it in the specification. The various passages relating to the filament read as follows:—

I have discovered that even a cotton thread properly carbonised . . . or if any fibrous vegetable substance . . . that if such fibrous material be rubbed with a plastic compound of lampblack and tar . . . small pieces of this material [lampblack and tar] may be rolled out in the form of wire . . . When fibrous material is used . . . I have carbonised and used cotton and linen thread, wood splints, paper coiled in various ways, also lampblack, plumbago and carbon in various forms mixed with tar.

As filaments made of lampblack and tar rolled out into wire and then carbonised have not been used in practice, we have to consider here only the filaments made of cotton and linen thread, wood splints, paper and vegetable fibrous material. In short, only high resistance filaments made of fibrous vegetable material are protected by this claim and no other. The claim speaks of a high resistance carbon filament made as described, and the specification describes

* New York *Electrical World*.

a filament made of fibrous vegetable material. The claim does not speak of a low resistance carbon conductor for series lamps to be used on arc light circuits, and the specification does not describe such a conductor of low resistance. There is nowhere in this patent a description or intimation of a high resistance filament made of collodion or gelatine, *i.e.*, structureless filament; there is no description or claim of a high resistance filament with mineral coating; there is no description of a carbon filament with a hard coating of structureless carbon as luminous surface; there is only described a high resistance filament of carbon of fibrous vegetable substance, not treated or flashed, a filament left in that porous condition in which it came out of the carbonising furnace. The court, in rendering the decision of July 14th, 1891, says: "By making it in a form of extreme tenuity out of such materials as are mentioned in the specification, carbonising it, and arranging it as he had previously arranged his platinum burner." There is not mentioned any one of the above filaments in the specification, consequently they cannot fall within the first claim of Edison's patent, because they were not made, not described and not claimed by Edison.

Now we have to consider the second claim of that patent. The same reads:—

2. *Claim.*—"The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purpose set forth."

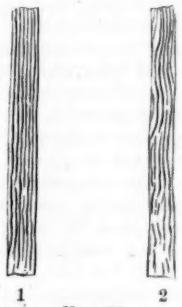
This is the combination claim. As before stated, a combination, when novel, is patentable even if all parts of the same are old as long as a new and useful result are achieved by it. In this combination, however, there is a new element and an old one. The all-glass closed chamber with leading-in conductors, *i.e.*, platinum wires sealed in the glass, is the old element. It was in use before and was generally known. Geissler tubes had been for 20 years (since 1860) and are to-day a commercial product. The new element was the high resistance filament of carbon made of such materials as are mentioned in the specification, and Edison certainly was entitled to a claim for a combination of that specific filament with an element that was old and public property at that time. He could combine it with an all-glass chamber, and if he could have achieved a new or useful result by combining it with a wood screw, he could have done so, but that combination would not have prevented the public from using screws or all-glass closed chambers which were old, well-known things and public property. The public, on the contrary, could, as well as Edison, combine these old elements with anything it pleased or saw fit, and we will now see whether such combinations with an all-glass closed chamber were in use before Edison combined his specific filament with it. There was:—

(1) The Geissler electric tube. It has embodied in it the combination of a luminous bridge consisting of the residue of rarefied gases with an all-glass closed chamber having conductors hermetically sealed in so that the currents can be introduced and the vacuum maintained. There was (2) Crookes's radiometer with the incandescent platinum ring. In that radiometer the incandescent conductor (platinum ring) forms a combination with the all-glass closed chamber, which is also provided with the leading-in conductors sealed in hermetically so that the vacuum could be maintained. Whether such combinations were patented or not is immaterial; if not patented, inventors simply made a mistake in not protecting their inventions or scientists generously presented their discoveries to the general public. We have only to ask here, were such combinations made before or not? They were, as we have already seen. Further (3) a high resistance filament of platinum also forms such a combination with an all-glass chamber. (4) The series carbons of low resistance which are no filaments but short, thick incandescent conductors, form also such a combination. (5) The structureless filament of artificial material (collodion or gelatine) forms another combination with the all-glass chamber. (6) The filaments with mineral coatings form such a combination. (7) The filament with a hard coating of structureless carbon as luminous surface also forms the combination. From the previous statements it is clear even to the non-professional that all Edison ever described and protected by the first two claims of his patent of January 27th, 1880, is a filament of carbon of high resistance, "made as described;" that is, a high resistance carbon filament made of fibrous vegetable material, not treated or flashed, or, as the court expressed it, "out of any such materials as are mentioned in the specification." It would, of course, have been a very different thing if Edison had invented the all-glass closed chamber, with the leading-in conductors sealed in hermetically by the fusion of the glass; then the second claim would have prevented anybody from using such a chamber. But that chamber was old and public property, and there were also combinations with it before, as is proved by the first two instances referred to above. There is undoubtedly a generic connection between the first and second claim of a patent, and consequently the second, or combination claim of Edison's patent of January 27th, 1880, quoted above, has reference only to such carbon filaments as are protected by the claim, *i.e.*, filaments out of such materials as are mentioned in the specification. Edison certainly only wanted to protect what he had invented and described in his patent, but this did not include low resistance conductors, &c.

There is another and the most important question to be answered yet, and that question, in a nutshell, is:—

Which of the many progressive steps in the art of incandescent lighting was the step that made the incandescent lamp a commercial success? This question can be answered by physicists and electrical experts only; but as there were no incandescent lamps in the market before 1880, the public had also a chance to form an opinion by observing who first put lamps successfully on the market. The first three installations made outside of laboratories were at Hazel's drug store in New York, on the steamer *Columbia*, and in the Equitable Building in New York. All of these were made in 1880 by two companies, on the *Columbia* by the Edison company, the two others by the United States company. The first installation was at Hazel's. The public saw that two companies put lamps on the market at almost the same time, but it was the expert's business to decide which company had the best and most reliable lamp at the time. The Maxim lamps of the United States company had high resistance filaments prepared in a hydrocarbon atmosphere, by the process perfected by Maxim. The luminous surface of these filaments consisted of that hard coating of structureless carbon before mentioned, while Edison's lamps were provided with high resistance carbon filaments of fibrous material, left in that porous condition in which they came out of the carbonising furnace. Prof. G. F. Barker, speaking also for Profs. Draper and Morton, said in the *Evening Post*, November 22nd, 1880: "There is no doubt in my mind, or in that of Profs. Morton and Draper, as to the value of Mr. Maxim's remarkable discovery. For years I have been an admirer of Edison's search for the true solution of the electric light problem, and I can testify to his unremitting energy, and the exhaustive nature of his search, but another man found it." Yes, another man had found it, another man had made the step in the progress of the art which made the lamp a commercial success. The Edison filament, left in that porous condition in which it came out of the furnace, may fairly be compared with the telephone invented by Reis, which transmitted musical sound, while the Maxim filament, prepared in a hydrocarbon atmosphere, may be compared with the Bell telephone, which transmitted articulate speech. It was the true solution of the incandescent lamp problem. This is not an assertion of to-day, as it was recognised in 1880 by the three above-named eminent scientists of world-wide reputation. The truth of that statement has been verified by measurements made in Dr. Werner Siemens's works in Berlin, the results of which are found in the *Electrotechnische Zeitschrift*, Berlin, November and December, 1885. The results proved that over 30 per cent. more light is produced with the same power with treated filaments than with untreated filaments, and that is a practical—a commercial point. Besides, the treated filaments maintained their efficiency more uniformly during the average lifetime of the lamp than untreated filaments, and this for the very plain reason that the treated filament, with a hard coating of carbon as luminous surface, is by no means so liable to disintegration or volatilisation by the mechanical action of the current as is the untreated fibrous filament left in that porous condition in which it comes out of the carbonising furnace. Fig. 9 shows a cross-section of bamboo, taken from that part of the bamboo from which

filaments are cut, magnified so that the little circle represents about one-hundredth part of an inch, that is about the size in which bamboo is cut for filaments. It shows the pores as well as the places where the substance is densest, and as the little circle represents the size of a filament in the drawing, it is plain that such a filament can be cut from the parts where the material is densest as well as from the part where the pores are largest, or the filament may be cut partly from the densest and partly from the most porous part; in other words, these filaments cannot be of uniform resistance; they have to be treated or flashed, that is, the pores must be filled up by electrolytically decomposing hydrocarbon gas and depositing carbon in the pores until the required resistance is obtained, and as the maker has it in his power to stop the deposition of carbon when he pleases by simply turning off the current at the proper moment, it is possible to make filaments of any desired resistance uniform and reliable, while we have no control of the filament while it is baked in the furnace, nor can we cut them while seen under the microscope so as to get through all of the densest portion of the material. The superiority of the structureless filament made of collodion or gelatine, made of a uniform, homogeneous mass, suggests itself after these explanations. That treating process was never patented in Germany, but it was patented by Sawyer and Man in Great Britain (Patent No. 4,847, in 1878). The patent was bought by the Edison and Swan United Electric Light Company, Limited, and it was sustained in court in a suit of that company against Woodhouse and Rawson, of London, in 1886. Justice Butt said :—"The process by which the desired result is obtained is, to my mind, one of singular beauty and efficacy." If a filament is treated to a certain extent, if it is much treated, it can be distinguished from an untreated filament by the naked eye of any experienced person. The smooth, silvery, rather metallic looking surface indicates the treating, while the untreated filament looks like carbon. If, however, it is treated only a small amount, it is hard to say whether the filament was treated or not; but in any case there is on the filament one or more spots where the most carbon has been deposited, and these have a smooth shiny surface, and if that part is brought under a microscope next to a part of an untreated filament, the microscope will reveal the fact that the filament is treated. Fig. 10 represents an



1 2

Fig. 10.

untreated and a treated filament. The untreated under the microscope looks black like coal, and appears smooth when examined with a lens magnifying about 50 times its diameter, while the treated filament has in proper light a silvery appearance, and looks as if it had a number of silvery strips on its surface.

Fig. 11 represents heated filaments as seen under the microscope by a lens magnifying about 50 times the diameter. All fine pieces are made from one filament, which had at the start 450 ohms resistance. The thinnest was treated down to 300 ohms, then a piece was broken off, and the rest treated to 200 ohms, and so forth to 100 ohms, to 50 ohms, and the last to 25 ohms. All five were mounted on one glass, so that they can be seen at once under the microscope, where they present the appearance in the cut. With reference to volatilisation, it may be stated here that it is an erroneous opinion held by many that volatilisation is due to that trace of oxygen contained in that trace of air which cannot be removed by exhaustion. That oxygen is said to combine with carbon, forming carbonic acid gas, and this carbonic acid gas is said to be decomposed on the inside glass wall, leaving the carbon on the inside surface of the glass; then the oxygen is said to return to act on a new particle of carbon, and so forth. In the first place, carbonic acid gas is never formed when oxygen and carbon act upon each other when carbon is present so much in excess. Under such conditions, as every chemist knows, only carbon oxide is formed, and, further, what chemical power is there on the glass walls to decompose carbonic acid gas or carbon oxide? There is none. Volatilisation is only due to that mechanical power of nature here employed. It is due solely to the mechanical action of the current. The word "Zerstäubung," that is, throwing off as dust, explains exactly what is done, and the softer a filament, the more it is liable to volatilisation, and the harder it is, the less liable it is to this action. This shows, too, the importance of the treating process, and there is, so far as my personal knowledge goes, not one lamp factory in this country or in Europe that does not treat its filaments at all. Edison, however, says that he does not treat the lamp filaments. The carbonising in the furnace alone and the "recarbonisation by the current," without the aid of some hydrocarbon gas, will never produce filaments of uniform resistance, especially not of fibrous materials. This is the general experience, but we must accept that rather singular statement that Edison filaments are not treated. The very best filaments of to-day, the structureless filaments made of collodion or gelatine, which are more homogeneous than fibrous filaments, do not come out of the furnace of uniform resistance. No matter how carefully they are made and cut into exact length before being mounted, no matter how carefully they are selected with the micrometer as to exact thickness, that is uniform sectional area, they do not come nearer than within 15—20 volts when burned at uniform candle-power, and that with an experience and skill of ten years in the art.

1 2 3 4 5

Fig. 11.

There is one passage in the decision of July 14th, 1891—Edison Electric Light Company *v.* The United States Electric Lighting Company—which I would like to quote. The court says :—"The claim is not limited to a carbon filament made of non-fibrous material." It is clear to the professional that the non-fibrous filament in question is the filament made by Edison and described by him. In the specification of the patent in suit, he describes a filament made of lampblack and tar rolled out into wire and then carbonised. It has certainly no reference to the modern structureless filament, which, as we have seen, is principally ready before it enters the carbonising furnace, and which is a great commercial success, while the other has never proved to be practical.

In conclusion, it is fair to say that it is not more than right that an inventor shall reap the fruits of his labour. But we must not go too far in the other direction and concede to one inventor the fruits of the labours of thousands of other inventors who have done less, just as much or more, as the case may be, in the same line, especially when the step in the progress of the art made by that one inventor is not the step that brought the true solution of the problem that made the lamp a commercial success.

There has been said a great deal about the perfection of a complete system of incandescent lighting. The most important thing after the lamp is certainly the dynamo. What Edison thought about dynamos before 1879, when he began to experiment in that direction, he revealed to the world in his United States patent of August 5th, 1879, by the invention of his tuning fork dynamo. At a later date Mr. Upton

built the Siemens armature, perhaps because measurements made in England (Preece, "Parliamentary Report," May 2nd, 1879) had proved that the Siemens machine was the best, and that the Gramme machine came very closely to it—perhaps because Mr. Upton had been for a year a student in Berlin under the celebrated Helmholtz, where he had an excellent chance to study the Siemens machine, and it is an open question which everyone may answer for himself, whether the world would not have been surprised with a re-invention of the Gramme ring if Mr. Upton by chance had studied in Paris under Fontaine.

THE THEORY OF MAGNETISM AND THE ABSURDITY OF DIAMAGNETIC POLARITY.

WE have already noticed Mr. J. Parker's work on this subject which appeared in the August number of the *Philosophical Magazine;* it is continued in the September issue, in a paper which deals in upwards of 50 pages with certain mathematical considerations which we only propose to allude to.

It must first be observed that exception has been taken to some of Mr. Parker's statements in an editorial note, in which it is explained that the paper was not read before being published, or else it would have been referred back to the author for some important alterations.

The exceptions taken are to the statements :—

1. That there is anything new in the theory that diamagnectic action is really due to the paramagnetism of the air.

2. That no theory of diamagnetic action has been propounded. This "new theory" is at least as old as Becquerel (1850), and has been investigated by almost everybody who has worked at diamagnetism, and they are practically unanimous in the conclusion that diamagnetic actions cannot be explained by the paramagnetism of the air.

These undisputed experiments prove that such a theory as Becquerel's would require a vacuum to be paramagnetic. This is a new nomenclature, and does not make the old one absurd ; it involves, practically, what Mr. Parker says is non-existent, namely, one of the theories of diamagnetism.

As to Mr. Parker's second statement, namely, that no theory of diamagnetism exists, that is equally extraordinary. Chapter xxii. of Maxwell's Treatise is headed "Ferromagmetism and Diamagnetism Explained by Molecular Currents," and gives an interesting description of Weber's theory of diamagnetism.

The editor of the *Philosophical Magazine* suggests that if Mr. Parker had exercised his ingenuity in explaining how Weber's theory, which, being a possible theory, can be reconciled with Thomson's difficulty, it would have been more instructive than a dissertation on the absurdity of what undisputed experiments show to be real.

Doubtless Mr. Parker will be afforded an opportunity of replying to these strictures by the editor of the *Philosophical Magazine*, and if he does we shall think it only fair to notice his defence.

Since the paper with which he continues his consideration of the theory of magnetism and the "absurdity" of diamagnetic polarity, chiefly consists of some 50 odd pages of mathematical reasoning we find it incapable of useful condensation, and those of our readers who have been, so far, interested in Mr. Parker's work, are referred to the current issue of the *Philosophical Magazine*, page 253. We may notice, however, a few points which will indicate the plan pursued.

Since the properties of exerting actions at a distance by a magnet are mainly situated at or near the ends of the magnet, two long magnets are taken whose ends are so far from each other that they may be regarded as mathematical points, and whose magnetic properties are situated only at their ends. These magnets are supposed to be situated in a vacuum, and to be made to undergo a reversible cycle in which the velocities are constantly zero.

This example is used for the purpose of explaining fundamental principles of the subject.

To complete these fundamental principles, Mr. Parker adds the great principle of the conservation of magnetism, which asserts that whatever changes take place in the magnetisation of a system, the quantity of magnetism remains constant.

He states that he is unable to accept the manner of stating the fundamental definitions, &c., that are given in the ordinary text books, which definitions are "not definitions at all, but propositions in the kinetic theory of gases, and are possibly incorrect."

As an example of his own method, Mr. Parker thus treats a well-known definition in magnetism :—

"The force which tends to separate the two poles (of two long magnets, which are supposed to possess equal magnetic properties, but only in their ends, and which are placed in air at a distance of one centimetre) is partly due to the magnetisms of the poles themselves, partly to the magnetisation of the air in which the two magnets are placed, and partly to the inequalities in the pressure of the air."

Mr. Parker then goes on to consider at some length how magnetism is distributed in bodies. In the first place, he says, it is evident that a finite quantity of magnetism cannot be concentrated into a point, that is, into an indefinitely small sphere ; for any two parts of the sphere would exert very great forces on each other, and the sphere would fly to pieces.

A finite quantity of magnetism can be distributed on a finite area. For if σ be the quantity of magnetism per unit area, or the surface density, m an infinite plate, this plate will exert a magnetic force, $2\pi\sigma m$, on a body, P, with a quantity of magnetism, m. If P be a second plate on which the surface density is σ', the force exerted by the infinite plate on each unit of area of P will always have the finite value, $2\pi\sigma\sigma'$.

If we break a magnet into any number of pieces, each piece is found to be a complete magnet. From this it is inferred that each atom or molecule is a complete magnet, with equal quantities of positive and negative magnetism at its ends. The total quantity of magnetism on each atom or molecule is therefore zero, and the distribution on it may be supposed to be a surface distribution. To prevent any difficulty being felt with regard to surface distribution of magnetism, it may be mentioned that according to the physical theories of magnetism, all that is meant is a finite pressure or tension per unit area on the surface. The reason why in an ordinary bar magnet there is little manifestation of the magnetic properties except near the ends is supposed to be that the positive end of one atom or molecule, and the negative end of the next, partially neutralise each other.

To calculate to what extent the magnetism of successive molecules neutralise each other, some preliminary propositions are required. These are of a mathematical nature, and must be consulted in the original paper.

Mr. Parker next goes on to show how the energy of a magnetised system is discussed in the ordinary text books, and complains that they make no attempt to find the entropy of a magnetised system, stating that, apparently, until the appearance of Dubene's book in 1888, the rigid methods of thermo-dynamics do not seem to have been thought necessary.

He then discusses mathematically the condition of magnetic stability on a homogeneous body of uniform temperature, θ, incapable of losing or receiving, or losing heat, except at the constant temperature, θ, and afterwards endeavours to explain Weber's hypothesis of magnetism.

Summing up the analogies found between magnetism and gravitation in the case of homogeneous substances, Mr. Parker then states :—

1. Every "soft substance" (adopting the common nomenclature) is attracted when placed near one pole of a magnet ; and every body is attracted to the earth.

2. If a number of "soft" bodies be magnetised by a steel magnet the action of the magnetised "soft" bodies on one another may be neglected ; and if a number of small bodies be placed near the earth, their gravitational attraction on one another in comparison with that of the whole earth may be neglected.

3. If a "soft" body be immersed in a gas or liquid and then placed near the pole of a magnet, it will appear to be attracted or repelled according as it is more or less magnetic than the gas or liquid by which it is surrounded ; and if any body be immersed in a gas or liquid, it will appear to be attracted or repelled by the earth according as it is heavier or lighter than the gas or liquid in which it is placed.

The theory given is illustrated by some experiments of Faraday, described in Tyndall's "Diamagnetism," and Mr. Parker observes that "theory and experiment fit together so exquisitely that we cannot but wonder the true theory should not have been seen from the first."

He then describes how it is generally "attempted to gloss over the imaginary difficulties of diamagnetism;" these methods are severely criticised from Mr. Parker's standpoint.

The way used by Weber of treating diamagnetism, namely. the method of induced currents, is summarily dealt with. Mr. Parker says:—"To this I reply that I have already sufficiently disproved the common theory of diamagnetism, and, secondly, it will be proved in a future paper that the common theory of induced currents involves an absurdity, and can seldom be correct."

The rest of the paper is occupied by a discussion of a few important problems in the light of the new theory, namely:—

1. The well-known problem of Sir William Thomson, which is said to have been suggested by the story of the coffin of Mahomet.

2. The thermal phenomena, due to the motion of a "soft" body in the presence of a permanent magnet.

3. The method proposed by Jamin for the determination of the distribution of magnetism on a permanent magnet.

These examples are discussed also in Dubene's *L'aimantation par influence*, a book which seems to contain the first systematic application of the principles of thermo-dynamics to magnetism.

PRACTICAL PHOTOMETRIC RESEARCH.

By RALPH CONRAD RICHARDS.

(*Concluded from page* 418.)

Optometry.

In the last article of this series the optometer was described, and it was explained as an introduction that the detection of those qualities (for the estimation of which this instrument was designed) must be regarded as possessing importance of by no means secondary value; it therefore becomes necessary to deal with them in a practical manner.

It may be well to state in the first instance that the contraction of the iris varies in a most singular manner, and differs very greatly at different times, and necessarily with different persons; this apparently complex fact is to be traced to the very great disparity of acuteness of vision at different times, and also to a corresponding variation of optical perception in various cases; these facts render it impossible to establish what may (in the absence of a better term) be called *a standard* of optical perception. To put these facts to the test the writer, who is at present staying at Hastings, determined to make some practical use of the electrically-lighted pier. Accordingly, he requested several persons to describe the amount of detail perceived in each individual case about the arc lamps, and the accounts he received, about a dozen in all, were remarkable in many respects, but in none more so than the very great disparity between what each saw; out of a dozen cases, only one was able to perceive the various details in a manner at all corresponding with the writer's own case. To cite one very peculiar difference in this respect, several were able to perceive the arc through the milk-glass globes, whilst others were unable to do so. Now, anyone observing an arc through such a globe will, if this be very brilliant, be able to see the whole globe fairly uniformly luminous, but if the eye-lids be gradually closed the arc becomes visible, and increases in this respect until the lids are closed. This is a difficult phenomenon to explain, but when one finds some persons able to see the arc without closing the lids at all, it clearly shows the existence of the disparity before mentioned. By the writer's own rough observation, the ability with which one is enabled to perceive the detail of surrounding objects while the direct rays from the radiant arc entering the eye, depends greatly—very greatly—upon the brilliancy, but also upon the luminosity, and it seems probable that this latter has a great deal to do with the question. Now, to investigate the matter more fully, it will be necessary to deal with a vast number of luminous sources, and as it is impossible to place them upon the same footing as regards luminosity, it becomes necessary to reduce them to a common standard, and the most convenient method of doing this is by means of smoked glass wedges. Below is appended a list of various luminous sources so treated:—

Table.

Light source.	Light in candles.	Brilliance.
1. Gas flame (ordinary fish-tail)	10	·2
2. Oil lamp	12	about ·5
3. Incandescent lamp	16	20
4. Arc ,, ...	1,000	about 100
5. Piece of magnesium ribbon, burning 1 in. per second...	150	50
6. Lime light	300	50

The brilliance was tabulated by estimating the radiative surface in each case and dividing this into the luminosity.

Observations show that the pupil is dilated in proportion to the luminosity, supposing the brilliance to remain a constant quantity; but if the brilliance be increased, the luminosity remaining constant, then the iris will be contracted in proportion to this increase.

Here, then, is a very important fact, and one whose consideration cannot be over-estimated, for on it lies the whole knotty question of final efficiency. It has been emphasised that though the total luminous radiation cannot be too high in order to gain the best results, in like manner it may be said that the brilliance should be as low as possible, provided that only the required area (*determined by actual requirements*) be illuminated. This, then, concludes all the necessary remarks upon optometry. It may be said that the optometer devised by the writer may be used as a photometer, where it is not necessary to have very accurate results.

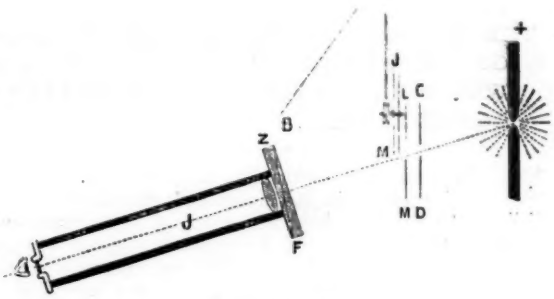


Fig. 10.

To use the instrument in this manner, the two screens, L M and C D, are dispensed with, and a piece of white card, on which is painted a conspicuous black cross, is inserted in the place formerly occupied by L M. A small stop is inserted at the end of the telescope, permitting the centre of the cross screen to be seen (a circle whose diameter is about 6 inches). The sector discs are now brought up close to the stop, in such a manner that it just covers the aperture in the stop.

It will be obvious on rotating the disc that the necessary adjustment will depend upon, and be proportional to, the luminosity; the extinction method is capable of many applications in the science of photometry, such, for instance, as the determination of the luminosity at various regions throughout the spectrum. The method possesses the great advantage of being independent of the colour of the rays under examination, and, provided that the observations be conducted by a keen-sighted non-colour blind person, are all that can be desired for rough work. It is only just to say that if such be the purpose for which the Varley photometer is intended, the criticisms to which the writer subjected that instrument some time back are superfluous. Regarding the use of reflectors, it should be pointed out that with their use the alternating becomes just as efficient as the continuous

current, and this very important fact should justify their introduction in such cases. It may be thought that in returning to this subject the writer is making too much of what appears to be of little importance to those who are ignorant of the matter, but it is quite reasonable to say that if these were once introduced, the many complaints which one so constantly hears in regard to arc lamp illumination would soon vanish, and probably the industry be greatly increased in importance. The concert room at Hastings is (to cite a n example) illuminated by four arc lamps, and in spite of the size of the hall (which is a very large one) the light is as perfect as could be desired. The writer was able to read the last edition of this journal with an ease quite equal to what he could do by daylight, notwithstanding the fact that the nearest arc to him was about 25 feet above his head.

Now, although the light was so powerful, he found it perfectly impossible to distinguish the detail of objects in its immediate vicinity when looking at the arc at the same time. This, then, is the only bane to a system of illumination which is otherwise perfect, and unfortunately it is a universal complaint. Surely the great pain which a brilliant light occasions in many people, and the discomfort which nearly all feel, should in themselves be sufficient to cause engineers to take a step in the right direction. The writer will be pleased to forward to anyone desiring to make the experiment an account showing how this may be accomplished in a rough and ready manner, and he feels sure that the result can but be satisfactory—as he has found it to be. Having touched on all the points which required elucidation, it is necessary to conclude these articles.

These points were :—

1. Physiological optics.
2. Location of illuminants.
3. Utilisation of electric light in plant culture.
4. Details concerning globes, reflectors, &c.
5. The efficiency of incandescent lamps, and
6. Optometry.

THE EFFECTS OF MAGNETISM ON RODS OF IRON, NICKEL, AND OTHER METALS WHICH HAVE RECEIVED A PERMANENT TORSIONAL SET.

DURING the past few months, Mr. Frederick J. Smith, the "Millard" Lecturer in Mechanics and Physics at Trinity College, Oxford, has been endeavouring to discover some form of chronograph stylus which would respond to rapid vibrations, and make a clear record of its vibrations on the moving plate of a chronograph, and he has succeeded in finding a combination which appears to give satisfactory results.

During the research several facts of interest bearing on a certain branch of magnetic induction presented themselves, and in the current issue of the *Philosophical Magazine* Mr. Smith gives a summary of some of them, an abstract of which will probably be of interest to many of our readers.

Mr. Smith first makes some reference to the history of his subject, and tabulates a number of references and papers wherein the action of magnetisation on iron subjected to stress has been investigated.

Wiedemann has shown that under certain conditions twisted iron wires untwist on magnetisation. He made his experiments on an iron wire suspended vertically and weighted with a considerable mass, and, by means of a convenient arrangement, torsion could be given to the wire.

Mr. Smith has made use of *rods* of iron, steel, and nickel which were *not* weighted, and had received *permanent* torsional set, and the magnetising force employed was many times greater than that used by Wiedemann.

The first experiment was arranged to find out whether a magnetic field of force acting on an iron rod subject only to its own weight would set up a torsional stress in it. By means of the arrangement adopted it was possible to accurately measure any minute torsion in the rod.

When an iron rod, 50 cm. long by 0·162 cm. in diameter, was subjected to a magnetising force of 21·5 C.G.S. units, a rotation of 0·1 cm. was produced in a direction, with clock-hands, to a person looking down the rod from its fixed end. When the current was broken the rod instantly returned to its initial position. A delicate thermometer showed no change of temperature, and hence the effect produced must have been due to the magnetising force alone.

The rod was now replaced with one which had received a permanent torsional set of seven revolutions, clockwise, to a person looking down it from the fixed end. It was then subjected to a force = 21·5 C.G.S. units, which instantly produced a further torsion in the *same* direction as the initial torsion.

On reversing the current, the direction of torsion was not reversed.

A similar rod, with the same amount of torsion counter clockwise, was further twisted by the magnetic force in the direction of the initial torsion, and when the current was off, it returned to its original position. Subsequent experiments showed that there was a limit to this torsion by magnetism.

The next experiment was arranged to find out any relationship which might exist between the magnetising force and the amount of torsion.

An iron rod, 0·16 cm. diameter and 50 cm. long, with torsion as before, was successively magnetised with an increasing force. A tabulation of the results showed that for low values of this force, the deflection is nearly proportional to the force, and that after a certain value it becomes permanent, and then begins to fall off, indicating an untwisting.

Mr. Smith is now arranging a large battery of accumulators for the production of very much more intense magnetic fields, in order to find out the rate at which the rod untwists after the maximum deflection is reached.

In the orignal paper the results obtained are arranged in the form of a table.

Other similar rods, having a permanent torsion of 2, 3, 4, &c., showed, on experiment, that for a small magnetising force the deflection rose almost proportional to it ; and that after a certain point further torsion was not produced by increasing the magnetising force ; and that ultimately, with a greater magnetising force, the rod began very slightly to untwist.

The next experiment was made to discover any relationship which might exist between the initial torsion of the rod, and that added to it by the force of the magnetic field when the magnetic force was constant. A tabulation of results (given in the original paper) shows that up to some value of initial torsion, between 10 and 15, the deflection produced by magnetisation is a maximum, and then it decreases as the torsion rises.

Subsequent experiments suggested by certain readings taken in this last experiment showed that when a rod having permanent torsional set was used in induction experiments with a ballistic galvanometer, the induction followed in value a slow change of torsion in the rod.

An experiment was now made to show this step by step unwinding of torsion after magnetisation in the case of a rod of nickel, the experiment being carried out in a manner exactly comparable to that with the iron rods. And it was shown that the behaviour of nickel appears to be the same as that of iron, but in nickel the increase of torsion with magnetisation is not so great. Mr. Smith shows graphically, by means of an ingenious diagram, this step by step untwisting of nickel.

Rods of non-magnetic metals, copper, platinum, lead, silver, zinc, cadmium, brass and bronze, were subjected to the same treatment as the iron rods, but no rotation of any kind could be seen.

A rod of bismuth, when treated as the iron rods were in the previous experiments, showed no apparent movement whatever ; from its brittle nature, however, it could be subjected to only a slight amount of torsion.

The next experiment was on a transitory current of electricity induced in a magnetic core subjected to permanent torsional set. To understand this properly, our readers should refer to the original paper in the *Philosophical Magazine*, where diagrams are given and the details carefully explained. We may observe, however, that in order to get a transient current from an iron core well annealed, its magnetisation must be reversed.

An examination of cores under stress shows that the phenomenon may be modified.

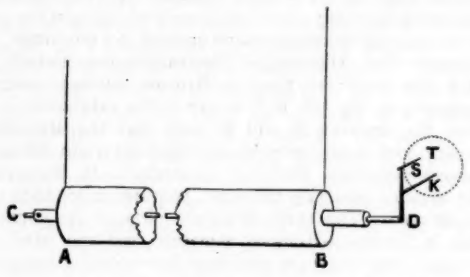
The remarkable feature of the phenomenon appears to be that it is only on the entire reversal of the magnetism of the core that the transient current is produced in any marked degree.

None of the effects could be produced with brass or copper cores, so that the current from the iron core is due to the reversal of the magnetic matter of the core.

Similar experiments were next made on cores which had a torsional set; in all the experiments already referred to, the cores were as free from torsional stress as possible.

In those experiments with cores subjected to torsional set, the same markedly large deflections, immediately after the reversal of the magnetising current were clearly shown, but now only large *in one direction*; the direction depending on the direction of torsion of the core.

Several tables of results exhibit the relationship existing between the direction of the magnetising current, the iron core current, and the torsion of the core.



There are also tables which give the results of several modifications of these experiments which are well worth a careful study, and some of the relationships proved are shown graphically by means of diagrams.

Our notice of this paper would not be complete without reference to the construction of the torsional magnetic stylus which Mr. Smith has devised.

In the figure:—

A B = long solenoid, shown broken to save space.
C D = twisted wire of iron.
S = aluminium pointer, which is adjusted to touch the smoked glass plate of the chronograph.

Repeated tests have shown that the "latency" of this new form of stylus is exceedingly minute, a fact which will make the instrument very useful for getting accurate chronographic measurements.

Mr. Smith also found that when the stylus is connected by means of a thread or fine wire to a mica tympanum, T, true telephonic effects could be obtained when a suitable transmitter is placed in the circuit, the articulation being clear.

The beautiful experiments of Prof. Hughes and of Prof. Ewing on transitory currents were made on wires in which torsional set had not been produced. In Mr. Smith's experiments rods with permanent torsional sets were in all but two cases employed.

The paper, of which the above is an abstract, occupies some fourteen or fifteen pages in the *Philosophical Magazine* for October, and is well worth reading in detail.

A SUBSTITUTE FOR GERMAN SILVER

With a view to obtain, if possible, a cheaper and better article than German silver, that would be suitable for electrical purposes, Mr. A. H. Cowles has been for some time endeavouring to procure alloys of copper and manganese. He found that whilst pure metallic manganese could with difficulty be reduced by the ordinary methods, it could be cheaply reduced in the electric furnace. This fact has facilitated the production, after a long series of experiments, of a substitute for German silver, which is styled "silver-bronze."

The difficulties attending the casting, &c., of a pure manganese bronze have been surmounted by introducing into the alloy a small percentage of aluminium. The addition of 1¼ per cent. of this metal to the alloy converts it from being most refractory in the casting process to being most satisfactory in this respect. The addition of aluminium also produces an alloy of much greater non-corrodibility than either German or nickel silver. Silicon and zinc are also introduced with good results.

The "silver-bronze" alloy, which has been specially prepared for rod, sheet, and wire purposes, is of the following composition:—

Manganese	18·00	per cent.
Aluminium	1·20	„
Silicon	5·00	„
Zinc	13·00	„
Copper	67·50	„
	104·70	

This alloy has a tensile strength of about 57,000 lbs. on small bars, and 20 per cent. elongation. It has been rolled into thin plate, and drawn into wire of 0·008 m. in diameter.

The electrical resistance of "silver-bronze" is stated to be higher than that of German silver, and the hope is entertained that we have in it a material the resistance of which will be such that it will afford the electrician better and cheaper wire for the rheostat than any other alloy.

ELECTRICAL UNITS AND STANDARDS.

At the meeting of the American Institute of Electrical Engineers, held September 22nd, 1891, the following report was presented:—

Report of Committee on Units and Standards.

The committee, considering that the authorised and recognised names for four practical electro-magnetic units, at present unentitled, are needed by electrical engineers in America as well as in other countries, for dealing conveniently with magnetic circuits in analysis, discussion, and design, recommends to the Institute the four units as appended in detail, of magnetomotive force, reluctance, flux and flux-density, in the hope that if favourably considered, the Institute may further the endeavours of the next International Electrical Congress towards securing for them universally recognised titles.

List of New Units Practically Needed for Convenience in Dealing with Magnetic Circuits.

1. *Magnetomotive Force*; or difference of magnetic potential.

Simple definition.—The analogue in a magnetic circuit of voltage in an electric circuit.

Strict definition.—The magnetomotive force in a magnetic circuit is 4π multiplied by the flow of current linked with that circuit.

The magnetomotive force between two points connected by a line, is the line integral of magnetic force along that line. Difference of magnetic potential constitutes magnetomotive force.

Electro-magnetic dimensional formula, $L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$.

The absolute unit of M.M.F. is $\frac{1}{4\pi} \times$ unit current of one turn.

The practical unit is $\frac{1}{4\pi} \times$ ampère of one turn, or one-tenth of the absolute unit, *i.e.*, 0·0796 ampère turn gives the unit. The prefix kilo- would perhaps be occasionally used for practical applications.

2. *Magnetic Flux.*

Simple definition.—Total number of lines of force or total field.

Strict definition.—The magnetic flux through a surface bounded by a closed curve, is the surface integral of magnetic induction taken over the bounded surface, and when produced by a current is also equal to the line integral of the vector potential of the current taken around the boundary.

The uniform and unit time rate of change in flux through

a closed magnetic circuit, establishes unit electromotive force in the circuit.

Electro-magnetic dimensional formula $L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}$.

The absolute unit is one C.G.S. line of induction.

The practical unit is 10^8 C.G.S. lines.

Fluxes range in present practical work from 100 to 100,000,000 C.G.S. lines, and the working units would perhaps prefix milli- and micro-.

3. *Magnetic Intensity*, or induction density.

Simple definition.—Flux per sq. cm.

Strict definition.—The induction density at a point within an element of surface is the surface differential of the flux at that point.

Electro-magnetic dimensional formula $L^{-\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$.

Absolute unit, one C.G.S. line per sq. cm.

Practical unit, 10^8 C.G.S. lines per sq. cm.

In practice, excluding the earth's field, intensities range from 100 to 20,000 lines per sq. cm., and the working unit would perhaps have the prefix milli- or micro-.

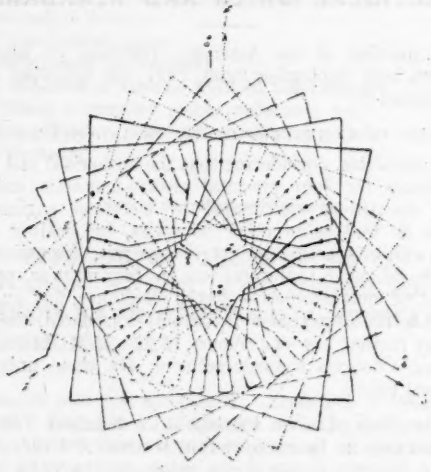
4. *Magnetic Reluctance.*

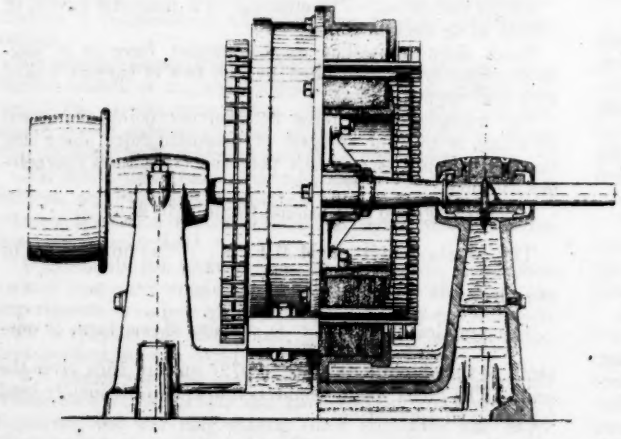
Definition.—Unit reluctance in a magnetic circuit permits unit magnetic flux to traverse it under the action of unit magnetomotive force.

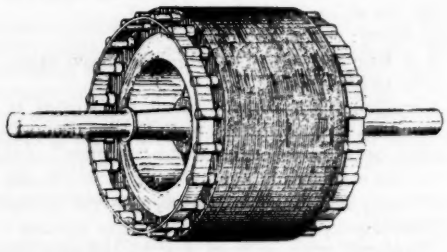
Dimensional formula $L^{-1} M^0 T^0$.

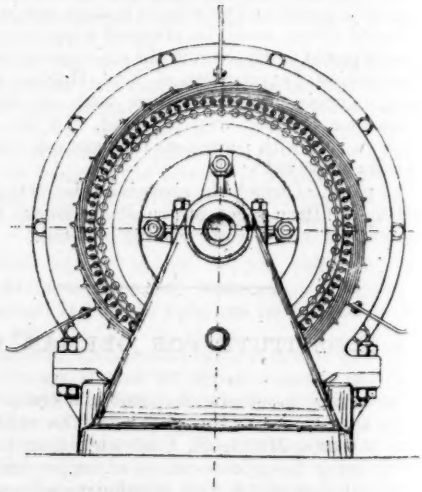
The practical unit is 10^{-9} the absolute unit.

Reluctances vary in present practical work from 100,000 to 100,000,000 of these practical units, so that the working unit would perhaps employ the prefix mega-.









C. E. L. BROWN'S 20-H.P. THREE-PHASE ALTERNATE CURRENT MOTOR.

GUIDED by the intention to avoid any sliding contacts with motors—as only in this way is it possible to approach the ideal of an industrial power producer—Mr. Brown took up the study of the multiphase current in the middle of last year. In this system he perceived a sure way to reach the above mentioned object. At the same time it was reported that the Allgemeine Electricitäts-Gesellschaft, in Berlin, had worked in this line, and had already obtained satisfactory results. In consequence of that the Oerlikon Works put themselves in communication with this firm. The result was that both firms united themselves to improve and expand the multiphase system. In August, 1890, a 2-H.P. motor, having no sliding contacts, was finished in Oerlikon after Brown's design. This motor has to be looked at as the first real commercial multiphase motor constructed up to that date. In this motor, for the first time, a hole armature in connection with Gramme winding was employed in the multiphase system. In the first days of the same month, Brown applied the hole armature in connection with drum winding to the 300 H.P. generator and motor designed for the electric transmission, Bülach-Oerlikon, which plant, as probably not generally known, gave birth to the Frankfort-Lauffen experiment. One of these machines is working at present in Lauffen. The hole armature in this application offers besides the many other well known advantages the possibility of reducing the magnetising current to a minimum. For this reason the Allgemeine Electricitäts-Gesellschaft also adopted the same for their multiphase current motors, as for example, in the 100 H.P. motor in the exhibition.

From the drawing it will be seen that the armature is stationary, and in the general arrangement quite similar to the above-mentioned 300 H.P. generator. In consequence of the smaller size, the armature contains more than three wires per pole. The three armature circuits are connected up like a Thomson-Houston armature, and the winding is so arranged that there are produced four rotating poles, with 40 cycles: the motor makes about 1,200 revolutions per minute. The normal tension for the motor is 80 volts, a reduction to 50 or an increase to over 100, will not make a practical difference in the speed. Of course, in the first case, the heating of the armature wire is a more considerable one, in the second, the iron heating is increased. The magnet field, in this case rotating, is produced by the armature reaction, avoiding in this way all sliding contacts. The magnet field is composed of a laminated ring with holes, in which are placed isolated copper bars, the free ends on both sides are connected by copper rings; this produces the whole field and it is not easy to imagine a more simple construction. Before giving results of the trials, some general data

of the motor may be of interest. The armature has 90 wires of about 40 mm². section; the mode of winding and connecting up is shown diagrammatically in the drawing. The copper weight is 20 kg., the iron weight about 100 kg.; the breadth of the armature is 200 mm., the outer diameter about 500 mm. The rotating magnet carries 54 copper bars with a section of 100 mm². The weight of the copper is 15 kg., that of the iron is 70 kg. Recent trials in Oerlikon with this motor showed that it can easily supply 20 H.P., the heating even with a continuous run is under normal, as no part of the motor showed a higher temperature than 20—25° C. above the temperature of the test room. It may be of interest to mention that the rotating armature shows practically no heating. The difference of speed between no load and full load is only about 3 per cent. The torque of the motor at starting is quite a considerable one. It could easily put in motion a 25 H.P. ventilator. The same is the case with an extra excited dynamo, which was working on a 20 H.P. absorbing resistance. Over 200 kg. torque could be obtained on the 20 cm. pulley. The motor can carry also a considerable overload and runs without the least noise. The starting of the motor is similar to a continuous current motor controlled by a resistance in series with the armature circuit. Regarding the commercial efficiency no accurate tests have been carried through. The losses are about the following: In armature, copper and iron, they amount to about 4 per cent., in the magnet copper and iron, including friction, to 4 per cent. From this results an efficiency of 92 per cent. A commercial efficiency of 90 per cent. can be taken as absolutely sure. That the losses are very small is further clearly shown by the very moderate heating, in spite of the small size of the motor and the trifling ventilation. A further advantage is that the commercial efficiency remains a high one, even if the motor works considerably underloaded. The weight of the motor is 420 kg., that is to say a trifle over 20 kg. per H.P. For locomotive purposes it would not affect the solidity of the design to reduce the weight to 300 kg., the result of which would be only 15 kg. per H.P. This result must be looked at as a very good one, especially considering the low current density the motor is worked with. As the bearings are automatically oiled and contain large oil reservoirs, this motor can run without any control for months.

NOTES.

The Electric Light in Preston.—The Preston Town Council have decided to light some of the principal streets of the town by means of the electric light.

The Electric Light at Aldershot.—The engineer authorities at Aldershot Camp have under consideration, amongst numerous other improvements, a scheme of electric lighting.

The Halifax-Bermuda Cable.—A telegram from Ottawa, states that it is understood there that the Canadian Pacific Railway and the Commercial Cable Companies have secured the controlling interest in the Halifax-Bermuda cable, with the view of extending telegraphic communication to the West India Islands.

The Electric Light in Piccadilly.—The Princes Hall in Piccadilly, W., is being fitted throughout with the electric light. The work is in the hands of Messrs. Hulett & Co., of Holborn. Messrs. Milners Safe Company, Limited, are also opening a West End depôt in Piccadilly, which is being fitted with the electric light by Messrs. Girdlestone, Tatham and Co., of Davies Street, Berkeley Square, W.

The Electric Light in Shaftesbury Avenue.—The handsome pile of buildings in Shaftesbury Avenue, now occupied by the United Nation's Club, are being fitted throughout with the electric light by Messrs. Rashleigh Phipps and Dawson, of Berners Street, W. The premises of Messrs. John Crüikshank & Co., outfitters, have also recently been fitted with the electric light, the work having been carried out by the Electric Power and Traction Company, Limited, Kentish Town.

Sevenoaks Lighting.—Referring to our note last week under this heading we are requested to state that the Board of Trade in a communication dated October 6th, 1891, have granted the request of the Electric Trust, Limited, for an extension of time.

The Chinese and Telegraphs.—The construction party sent by the Imperial Chinese Telegraph Administration to erect a line through the Hunan province, has been compelled to retreat after a stubborn fight with the people at a place called Sarshee. The mob burned 1,200 of the telegraph poles.

More High Conductivity Copper.—Messrs. Thomas Bolton and Sons advise us that in future all their H.C. copper will be guaranteed to have an electrical conductivity of not less than 100 per cent. of that of pure copper, according to Matthiessen's standard.

Electricity versus Gas in Liverpool.—Councillor E. Purcell, at the meeting of the City Council, on Wednesday, moved that the Watch Committee be instructed to consider and to report to the Council as to the advisability, best method, and probable cost of using the electric light in lieu of the present mode of lighting the city.

Universal Time.—Referring to our leaderette on this subject in our issue of September 25th, we learn that Dr. Gill, the Cape Astronomer Royal, is endeavouring to bring about universal time throughout South Africa, and should he succeed, the resulting convenience, it is said, would be enormous.

"Electricity" Lectures.—The first of a course of ten lectures on "Electricity," and its modern applications, was given by A. H. Fison, D.S.C., F.R.A.S., on Monday Evening, October 5th, at Toynbee Hall, 28, Commercial Street, E. The first lecture was free, and the fee is one shilling for the whole course, which will be continued each Monday.

Cases of Mistaken Identity.—We have received some copies of the *Trade Marks Times and Patents Records*, which contain articles on "Official Tyranny," and those who believe that the English Patent Office system is rotten to the core will peruse these papers with interest. But that which claims immediate attention is the portrait of Sir David Salomons in No. 21. Vol. I. Most electrical men are well acquainted with Sir David's personal appearance and also know that he is only about 49 years of age, but in the journal to which we refer he is depicted as a clean-shaven white-haired full-faced Wellington-nosed old gentleman, of at least three score years and ten. Whilst upon this subject we might add that the portrait of a well-known violinist in last week's *Electrical Engineer*, is evidently intended for the Manager of the *Electrician* or some other friend of the genial editor.

City and Guilds of London Central Institution.—Of the candidates, some 100 in number, who presented themselves for the recent Matriculation examination at the City and Guilds Central Institution, 64 passed and 14 did sufficiently well to be admitted as unmatriculated students. In addition to the students who came forward from last session, and the foregoing 78, all now attending courses in each of the four departments of the college, some 14 special students have entered for advanced courses and 59 for the courses on carpentry for elementary teachers. The departments of mechanical and electrical engineering have now their full number of students. At this entrance examination, the Clothworkers scholarship of £60 a year and free education for two years, was gained by J. R. Dick, B.Sc., Edinburgh University, the Siemens Memorial scholarship of £50 a year for three years by F. Maeers, St. Dunstan's College, Catford; the Mitchell scholarship of £30 a year and free education for two years by E. L. Joselin, from the Finsbury Technical College; and the three Institute's scholarships giving free education for three years, were awarded to S. Mendel, Charterhouse School, R. J. C. Woods, educated abroad, and W. H. Everett, Queen's College, Belfast. At the close of the last session, the John Samuel scholarship of £30 and free education, granted to the best second year's student and tenable for his third year, was gained by F. H. Hummel, and the Siemens medal by G. C. Turner.

The Grand Duke Alexis of Russia's Steam Yacht "Strela."—The new and magnificent steam yacht *Strela*, recently completed by La Société des Ateliers et Chantiers de la Loire, for his Imperial Highness the Grand Duke Alexis of Russia, is fitted throughout with the electric light. The whole of the electrical work has been carried out by Messrs. Sautter, Lemonnier et Cie., of Paris.

A Professor's Lament.—Our contemporary, *The Contract Journal*, referring to an editorial in the *Engineer* under this heading, thinks that journal far too sensitive in using plain language. In the article the contention of professors that engineers do not know their own business is disputed, and *The Contract Journal* states that the professors are handled more tenderly and delicately than they deserve.

Development of Flowers and Plants by Electric Light.—In the winter of 1889-90 experiments were made in America with a view to seeing what influence was exerted upon plants in greenhouses by the electric arc light. For this purpose a forcing house 20 feet by 60 feet, divided into two nearly equal portions by a tight board partition, was used. One compartment was treated to the ordinary conditions of sunlight by day and darkness by night, and the other had sunlight during the day and electric light by night. The general effect of the electric light was to greatly hasten maturity, and the nearer the plants grew to the light the greater was the acceleration. The plants grown under the influence of the electric light were sold two weeks earlier than those grown in the ordinary way. A few points have been proved and these are that the electric light promotes assimilation; it often hastens growth and maturity; it is capable of producing natural flavours and colours in fruits, and it often intensifies the colours of flowers, and sometimes increases their production. There is every reason, therefore, to suppose that the electric light can be profitably used in the growing of plants, and last week we referred to the art of electro-culture at some length in our leading columns.

The Telegraphists' School of Science, General Post Office.—The results of the recent examinations at South Kensington and the City and Guilds of London Institute have now been issued. They are in every way satisfactory, and Mr. Slingo is to be congratulated. The successes in the examinations of the Science and Art Department for electrical subjects are as follows:—Magnetism and Electricity.—Honours stage, second class certificate: Mr. J. E. Taylor. Advanced stage, first class certificates and Queen's prizes: Mr. G. Burtles, Mr. E. W. Cousins, Mr. T. S. Filmer, Mr. G. J. W. Hill, Mr. A. W. Martin, and Mr. E. H. Shaughnessy; second class certificates: Mr. A. C. Booth, Mr. J. T. Gillespie, Mr. W. T. Harris, and Mr. A. R. Nicholls. Elementary stage, first class certificates: Mr. E. Banwell, Mr. A. J. Eames, Mr. W. Dolton, Mr. C. Mason, Mr. B. Salmon, Mr. J. E. A. Sorrell, and Mr. W. Stevenson; second class certificates: Mr. J. R. Bourdeaux, Mr. E. J. Eames, Mr. A. F. Eginton, Mr. A. J. E. Harris, Mr. R. Kent, Mr. A. J. Rowlands, Mr. A. F. Tarryer, and Mr. E. Ward. City and Guilds Institute's Awards:—Telegraphy.—Honours grade: first class certificate: Mr. G. J. W. Hill; second class certificates: Mr. W. T. Harris and Mr. H. Sparkes. Ordinary grade: first class certificates: Mr. E. J. Shaughnessy and Mr. J. E. A. Sorrell; second class certificates: Mr. E. Banwell, Mr. G. W. Bullamore, and Mr. E. J. Eames. Electrical Instrument Making.—Ordinary grade, second class certificate: Mr. E. W. Cousins. Electric Lighting and Transmission of Power.—Honours grade, first class certificate and first prize in the United Kingdom, £3, and silver medal: Mr. G. F. Mansbridge. Ordinary grade, second class certificate: Mr. J. E. Taylor. Local Prizes.—For passing first class in telegraphy: Mr. G. J. W. Hill, Mr. E. H. Shaughnessy, and Mr. J. E. A. Sorrell. For passing first class elementary in electricity: Mr. E. Banwell, Mr. A. J. Eames, Mr. W. Dolton, Mr. C. Mason, Mr. B. Salmon, Mr. J. E. A. Sorrell, and Mr. W. Stevenson. For weekly exercises, telegraphy and electricity: advanced: Mr. G. J. W. Hill, Mr. A. R. Nicholls, Mr. A. W. Martin, and Mr. J. T. Gillespie; elementary first class: Mr. J. E. A. Sorrell, Mr. E. Banwell, and Mr. A. F. Eginton; second class: Mr. W. Stevenson, Mr. A. F. Tarryer, Mr. E. A. Coggon, Mr. R. Kent, Mr. C. Mason, and Mr. E. Ward. Telegraphy: Mr. E. B. Bothwell.

Water Power in France.—Recently a French paper sounded a warning note concerning the acquisition in France of various waterfalls, &c., by foreign companies, and urged Gallic manufacturers to make hay while the sun shone, and not to allow foreigners to monopolise such sources of power, to the ultimate detriment of the country.

Damage to Alternators.—A curious accident, says *Industries*, has recently occurred in connection with two central station alternators. They were to be coupled in parallel, but the synchroniser was connected up wrong. The result was they were put together half a period out of step, with disastrous consequences. One armature succumbed at once, and the other held out for a few minutes, but its constitution was irretrievably ruined.

Failure Through Electric Lighting Investments.—At the London Court of Bankruptcy on Friday last, a summary was issued of the affairs of Mr. Hugh A. Fergusson of Upper Berkeley Street. The liabilities are £26,166, of which £19,202 are expected to rank, and the assets are of uncertain value. The debtor attributes his insolvency mainly to losses incurred through investing in certain electric light companies.

The London Electric Wire Company.—This company has made arrangements by which all high conductivity copper supplied from this date will have a minimum electrical conductivity of 100 per cent. of that of pure copper, according to Matthiessen's standard. Having of late years greatly increased and improved its machinery, the company is now in an exceptional position for supplying large quantities of covered wires of any gauge at short notice.

Electricity for Stopping Horses.—A very successful and satisfactory public exhibition and test of the Holson electrical apparatus for stopping runaway horses was recently given in Chicago. The apparatus, which is very simple, appears to be nothing more than an ordinary set of harness with a small dry battery, the case of the latter being about 6 inches × 6 inches × 3 inches, under the driver's seat. From this through the lines or along the pole or shaft of the vehicle, extend wires to small metal electrodes placed within the nostrils of the horses—not in the tender portion of the nose, but in a tough, wet fold of skin and hair within the nose, so that no irritation is caused. Connection is also made with a push button at the driver's seat, and one inside the carriage. The inventor claims that the apparatus will not cause the slightest injury to the horses.

The Gülcher Company.—During the last six months the Gülcher Company has made some important strides. We understand that Mr. de Castro, their chairman and managing director, who has been making a long visit to New Zealand, has succeeded in largely extending the business of the company in that colony. The Wellington Street lighting installation, which has been working most satisfactorily for some three years, is now to be extended to include the supply of about 3,000 lamps to private consumers. The general installation work of the company in New Zealand is also largely increasing. In the meantime, an important order for a central station with plant for a first instalment of about 2,600 incandescent and 60 arc lamps has been secured, and will very shortly be in operation for lighting part of the City of Genoa. A branch establishment has been inaugurated in this city, and a number of subsidiary orders have been already secured by the company in Italy. In London, also, the company is busy with installations of more or less importance, including the lighting of the People's Palace at Mile End Road, and a large contract recently secured for the lighting of "Modern Venice" at Olympia, West Kensington. A considerable number of dynamos and auxiliary plant for shipment are also in hand. We are pleased to hear that the business during the last 10 or 12 months has made such progress, and that the company is now in a more flourishing condition than it has ever previously been in. Doubtless the large installations at the Spanish, French, and German Exhibitions, which they have so well carried out at Earl's Court, coupled with energetic management, have conduced in some measure to this result.

Stettin Electricity Works.—This company has earned during its first year's work, which has just terminated, a dividend of 3 per cent.

The Berlin Electricity Works.—The directors of this company propose to declare at the forthcoming general meeting, and after writing off a large portion of the capital, a dividend of 9 per cent for the year 1890-91, as compared with 10 per cent. in 1889-90.

Annealing Steel Wire by Electricity.—The electric current has now been in use for some time at the small arms factory at Saint-Etienne for annealing the steel wire employed for making the springs of the 1886 type of rifle. A current of 23 ampères at 45 volts is used, and a workman is said to be able to anneal 20 springs in three minutes, or 2,400 daily.

Electric Fire Alarms.—Mr. Lyon, the Chairman of the Fire Brigade Committee of the London County Council, has just called attention to an evil, the remedy for which is difficult to find. It seems that in twelve months the firemen of the Metropolis have been called out 500 times needlessly, owing to the mischievous pranks of people who have wantonly rung the electric fire alarms.

Larne Electric Lighting.—The commissioners, at a recent meeting, expressed their approval of the way in which the electric lamps were giving forth a good, steady, brilliant and effective light. A new agreement was also entered into for further extension of the electric light by Messrs. Gordon and Co., the electrical contractors, who will light the town of Larne with the extended boundary, with 10 arc lamps of 12,000 candle-power, and 49 incandescent lamps of 16 candle-power, for the sum of £200 per annum.

Telephony between America and Europe.—Some time ago it was reported that a scheme had been advanced to permit of telephonic communication between the United States and England, but no name was mentioned of the originator of the project. It now appears that this is Mr. Gorham Gray, of Boston. A German paper published in New York states that Mr. Gray has discovered, by means of tests (?), that telephonic connection between the two continents could be successfully carried out, and worked cheaper than a telegraph line. Instead of copper wires, Mr. Gray would use iron or steel wires!

Dover Electric Lighting.—A very interesting leader in the *Dover Standard*, headed, "Dover Waking Up," states that the negociations with the Brush Electrical Engineering Company having successfully terminated, a local company will be formed, and will be called the "Dover Electric Light Company," and the object of this company will be to carry out the terms of the provisional order granted to the Corporation of Dover. The company is to provide a supply for both private and public lighting. Terms have been arranged for the transfer of the undertaking to the Council at the expiration of 21 years, or of any subsequent ten years, at their option.

Electric Light in Ventnor.—At a recent meeting of the Ventnor Local Board, it was resolved that the board consider the advisability of lighting the town with electric light, and to appoint a committee if necessary. After some discussion, it was decided to refer the matter to the works, sanitary and lighting committee. The chairman said that they had already had notice from a company that it intended applying for a provisional order. It was agreed that the company should be notified that the board would strenuously oppose the application.

Electric Lighting in the West.—A report has been presented to the Town Council recommending that body not, for the present, to carry out the lighting of Tiverton by electricity themselves. It recommended the council to advertise for offers from persons or a company to undertake the powers of the provisional order for a specified term, the undertakers to state, *interalia*, the terms on which the council might, at the expiration of their term, purchase the plant. It was resolved that the report should be printed.

Electric Ventilators on Shipboard.—The French man-of-war, *Magenta*, has been supplied with seven electric ventilators.

Electric Lighting at Bristol.—At a recent meeting of the Kingwood Local Board permission was granted to Messrs. Parfitt and Son, of Keynsham, to erect poles and wires for the purpose of lighting by electricity the district known as the lighting area of the board.

Sports by Electric Light in America.—A carnival of out-door sports was held recently by the Manhattan Athletic Club. In the evening the Manhattan Field was lit electrically by 40 arc lamps and a 5,000 candle-power search light.

Bognor and Electric Lighting.—At a meeting of the Bognor Local Board, last week, it was decided to oppose the application of the Electric Trust, Limited, for an extension of the time for complying with the provisions of section 7 of the order as regards deposit, from six to twelve months.

Electric Lighting at Kirriemuir.—The Kirriemuir Linen Works have been lit up with electricity for the first time, to the great astonishment of the workers, many of whom had only heard of it by name, but were altogether ignorant of its power and brilliancy.

New Swiss Station.—A new central station is about to be built near Hundwil Bridge, between Hundwil and Herisau. The combined Sitter and Urnäsch water-courses will be used, and the turbines will yield about 1,200 H.P. Of this, about 400 H.P. will be utilised in operating the projected railway, St. Gall-Speicher-Trogen, whilst the remaining 800 H.P. will be employed for industrial purposes in Herisau, St. Gall, &c. The initial cost is estimated at £75,000, and a company has been formed to carry out the installation.

Gas Companies and Electricity.—At a meeting of the Commercial Gas Company, Limited, on Friday last, the chairman in the course of his remarks stated that they had great enemies in electricity and cheap oil, but the cheapness of gas had kept their enemies in abeyance. He thought it would be undesirable to raise the price of their gas as it would be giving encouragement to electric lighting.

New Parish Church, Hove, Brighton.—A very complete installation of electric lighting plant is being erected under the superintendence of Messrs. Morgan Williams and King at the new parish church, Hove, the church having been designed by Mr. J. L. Pearson, R.A.

The Electric Railway at the World's Fair.—The World's Fair Grounds at Chicago are now open to visitors for the inspection of the progressing work, and for their accommodation an electric railway of a most ingenious and novel character is being constructed. It is said to have a carrying capacity of 30,000 passengers per hour. This railway will differ from ordinary railways, in that the passengers are transported on a movable sidewalk instead of by cars of the ordinary type. The scheme is the invention of the Columbian Movable Sidewalk Company of Chicago, and the installation is being constructed under its patents. The sidewalk is to be on an elevated structure 25 feet high and 900 feet long, in the form of an ellipse, and is to consist of 75 cars, each 12 feet long, connected together, making one solid train. Two parallel sidewalks are to be constructed, one running at the rate of two miles an hour, the other at four, both walks moving in the same direction. The passengers can step from the stationary walk to the one which moves at the rate of two miles an hour, and if it is desired to move at a greater speed they can step from this walk to the one running at four miles an hour. The passengers can safely walk upon either of the movable sidewalks while in motion if desired. The structure will be illuminated at night by a number of Thomson-Houston incandescent lights. The entire train of cars will be controlled and operated by one man, and it is believed that this railway will be one of the leading attractions and novelties.

The New Theatre at Zurich.—The new and magnificent theatre recently completed at Zurich, was opened for the first time on the 30th ult. The whole of the building is lighted by the electric light, which so far has given most satisfactory results.

Telephones in Switzerland.—At the end of 1890, there were 9,492 subscribers to the telephone service in Switzerland being an increase of 1,486 over the number in 1889. The length of telephone lines was increased by 656 kilometres during the year, being now 4,579 kilometres.

The Electric Light in Canada.—St. John, N.B., which is said to be the most brilliantly lighted city in Canada, possesses five central stations for supplying the electric light. In addition to these, the city corporation has also a plant of its own.

Electric Tramways and Quick Postal Delivery.—In order to facilitate the delivery of letters, the electric tramways of the town of Burlington, Ja., U.S.A., now carry the letter carriers of the town on duty, at the rate of one dollar per month.

Edison on the Track.—According to the New York correspondent of the *Daily News*, Mr. Edison claims that he has devised a new method of using electricity as a motive power on tramways, which will do away with trolleys and storage batteries, by picking up the current from the rails. Experiments are promised with the new method upon the city tracks soon, which are awaited with great interest, as all the authorities believe that electricity is the motive power of the near future.

Electric Tramways in Brazil.—The town of Bahia, Brazil, is to have an electric tramway about 1½ miles in length, the gauge being only 2 feet 4 inches. The whole of the necessary plant, which is the first of its kind in Brazil, has been supplied by the Wenstrom Consolidated Dynamo and Motor Company, of Baltimore, U.S.A.

The Electric Light at Dusseldorf.—We learn that the central station which has recently been erected at Dusseldorf by Messrs. Schuckert and Company, of Nuremberg is now in working order and is giving great satisfaction. The generating plant is situated about 1½ miles away from the centre of the town, where most of the current is supplied.

The Electric Light in San Salvador.—The Compania de Alumbrado, of San Salvador, Central America, is considering the question of extending its electric light plant, and before inviting tenders, is desirous of receiving catalogues &c., from electrical engineering firms. Such catalogues and price lists as may be sent, should be addressed to the director of the company, Mr. M. Cohn.

A Large Electric Crane.—What is said to be the largest electric travelling crane in the world, has recently been erected in the Baldwin Locomotive Works at Philadelphia, U.S.A., by the Equitable Engineering Company of that city. The crane, which will carry a weight of over 100 tons, is equipped with two 40 H.P. Westinghouse constant-potential motors and one 5 H.P. Wenstrom series motor.

Railway Train Lighting by Electricity.—A correspondent writes :—"Mr. Arthur Shippey's proposal to utilise the waste heat of the railway locomotives for the above object, to say the least of it, is very novel, and certainly a remarkable one, therefore it is to be hoped he will pursue his experiments and report results. I note that Mr. Shippey speaks of low resistance lamps for battery lighting; but what is the good of creating our curiosity, and making our mouths water, if we cannot get them. The question one would like to know definitely is: Can such lamps be obtained? and if so, can they be used in England without infringing the rights of the Edison-Swan Company? In Paris and Germany good and cheap lamps are obtainable at a reasonable price; but in England experimental work becomes an expensive luxury, with lamps at present prices; therefore if we are to have the advent of a cheap and reliable lamp, I have no doubt that there would be plenty of customers forthcoming who would willingly purchase them."

Electric Lighting at Doublebois, Cornwall.—A complete electric lighting installation is being erected at The Mansion, Doublebois, Cornwall, under the superintendence of Messrs. Morgan Williams and King, the prime motive power being derived from a petroleum engine. Mr. F. M. Newton, of Taunton, is the contractor.

Telegraph Delays.—The General Post Office gives notice of considerable delay in telegraphing to all offices south and west of Exeter, Bristol, South Wales and Ireland. Communication with the Channel Islands by the English route is at present totally interrupted. Several of the cables to America are also idle.

Electric Launches on the Manchester Ship Canal.—As a sign of the approaching completion of the Manchester Ship Canal, we may mention that the General Power and Traction Company, Limited, are about to place several electric launches for service on the Canal, similar to those now plying on Lake Windermere.

Errata.—In the paper by Mr. du Bois, published last week, Frölich's formula should read

$$y = \frac{\frac{1}{Q}x}{1 + \frac{1}{Q}x},$$

lower down Corsepin's should be Corsepins', for (atoms) read atmospheres (atmos.), and in last line read $1700 > 1 > 50$.

National Telephone Company, Limited.—An interesting gathering took place at Sunderland on Saturday evening, the occasion being the presentation of testimonials to Mr. G. F. L. Preston, late engineer of the district, and Mr. R. A. Dalzell, local manager at Sunderland, on their appointment to other districts. Some 60 members of the staff were present, and the proceedings were opened by Mr. Clay, who said that some few weeks ago, when it was known that these two gentlemen were leaving the north, it was unanimously felt that they should not be allowed to go without some manifestation of the respect and esteem they had won for themselves during the six years or so of their engagement with the company here. A meeting was called, and held simultaneously, by means of the telephone, at Newcastle, Sunderland, Durham, Stockton, Consett, Darlington, and Hartlepool, at which 35 of the staff were present, and a committee was appointed. Subscriptions had been received from 150 members of the staff, resulting in the purchase of two handsome gold keyless watches, suitably inscribed, which he had much pleasure in presenting.

Cæsar and Pompey are Very Much Alike!—Shareholders in Elmore copper companies may be interested in reading the following extracts from an advertisement which appeared in the daily newspapers during the past week. They will observe that they are not alone in the possession of the advantage of Mr. Elmore's experience in designing plant; that another company has contemplated outputs (in a month), with largely-increased output (in three months); that broad acres and a railway of their own are common to both, together with the further advantage of having the prospective value of the shares set forth in no measured terms, *pro bono publico*. We have no knowledge of the other company, and do not desire to prejudice it by the comparison :—"The plant has been designed by Mr. William Elmore, whose name has been prominently before the public in connection with the Elmore copper depositing process, which has obtained so great a success. . . . It is intended to commence work on a basis of an output of 200 tons per week; plant has been erected for that purpose, and, Mr. Elmore states, will be in practical working order within one month. The company owns six acres of freehold land at Northfleet; they have built their own railway to a wharf on the Thames. . . . On the basis of a profit of £5 per ton (which is considered a low estimate) and an output of 200 tons per week, a dividend should be earned sufficient to pay 25 per cent. per annum. . . . When the plant is extended to an output of 400 tons per week, which, it is stated can be done in about three months," &c., &c.

The Crystal Palace District Lighting.—Mr. Frank King (of the firm of Messrs. Morgan Williams and King) has been appointed consulting engineer to the Electric Installation and Maintenance Company, Limited, who are the holders of the provisional order.

Electric Tabulating Machines.—In the forthcoming Austrian census, the electric tabulating machine invented by Mr. Hermann Hollerith, will be employed in the making up of the returns. This machine was also used in connection with the recent United States and Canadian censuses.

Quick Work.—We are informed by Mr. Slater Lewis that he has already succeeded in completing the equipment of the instrument, cabinet, insulator, and battery departments of his new works (the National Telegraph Works, Birmingham). Considering that this involved, of necessity, the selection and laying down of engines, lathes, machine tools, wood-working machinery, shafting, forges, furnaces, and a host of tools and minor appliances, and that barely a month has elapsed since the work was entered upon, we think it may fairly be described as rather quick work. We understand that Mr. Lewis has already commenced active operations.

Further Developments in Multiphase Motors.—The Oerlikon Works have recently turned out a "Drehstrom" motor containing a simple iron cylinder, which produces the rotating field, and minus the usual contact rings hitherto employed in all multiphase machines, except the very smallest ones, which were regarded as mere toys. The new motor is said to have a very high efficiency, combining with it simplicity of construction and cheapness. It has been decided, in spite of the fact that the Frankfort Exhibition is to be closed in the course of another week, to show this important invention in connection with the Lauffen transmission plant. The idea of Mr. Oscar von Miller, which was to the effect that new inventions should be admitted into the exhibition up to the very last day, will thus find another practical consummation. We await with great interest further details concerning this late addition to the "Drehstrom" exhibition.

New Electric Lighting Station.—To-morrow the foundation stone of the Generating Station of the Electric Installation and Maintenance Company, Limited, will be laid in Wells Road, Sydenham, by the chairman, Colonel Lewis Vivian Loyd, D.L., J.P. The contractors are Messrs. J. E. H. Gordon & Co., Limited, and the system adopted is that of a continuous current of moderately high pressure, connected with subsidiary stations for supplying a low pressure current to the consumers. The electricity will be converted into low pressure by means of continuous current transformers, with storage batteries for securing continuity and steadiness in the supply, the pressure being regulated by automatic apparatus. In the first instance about 500 horse-power of electrical energy will be transmitted from the generating station to the Crystal Palace, for the purposes of the electrical exhibition which opens on January 1st, 1892, and no time will be lost in laying the mains for supply of the consumers in the district. The price to be charged will be as a maximum 8d. per Board of Trade unit.

Oscillations in the Retina.—The idea of oscillation plays more and more a part in the explanation of various phenomena. One of the latest developments of this idea is seen in the explanation offered by Mons. Charpentier of certain effects in the visual apparatus when excited by light. He has been able to demonstrate, experimentally, the production of oscillations in the retina under these circumstances, which seem rather to be connected with a reaction of the retina, than with the act of sensation of light itself. Amongst the experiments illustrative of this which have recently been described by Mons. Charpentier before the Paris Academy of Sciences, we may note the following:—If in complete darkness an instantaneous luminous excitation be produced, the sensation appears doubled. This takes place, for example, when a single discharge from a Ruhmkorff coil is passed through a Crookes or Geissler tube or through air. The doubling is more or less precise according to various circumstances, but it is readily found again when it has been observed once; and it is particularly marked with indirect vision.

Brush Electrical Engineering Company.—The head offices of the company have been removed from Belvedere Road, Lambeth, to Albert Buildings, 49, Queen Victoria Street, E.C.

Proposed Lighting in Kilkenny.—Messrs. Waller and Manville have been retained by the Corporation of Kilkenny to advise them on the suitability of the introduction of electric lighting in Kilkenny.

The St. James' and Pall Mall Electric Light Company.—The electric current sold by this company for the quarter ending September 30th amounted to £5,279. Considering the time of year, this is a very excellent result, and the Company thoroughly deserves its success.

Postmaster-General's Report.—The Postmaster-General's thirty-seventh annual report, issued on Monday last, states that, for the year ending March 31st, 1891, the total number of telegrams dealt with, including press and foreign telegrams, amounted to 66,409,211, being an increase of about 4,000,000 on the previous year. The chief novelty in the telegraph service is stated to be the London-Paris telephone.

No Dividend this Year.—We desire to call the attention of our readers generally, and ordinary shareholders particularly, to the report of the International Okonite Company, Limited. The speech of the managing director will show clearly to those who can read between the lines how justifiable was our leading article which appeared in the REVIEW for July 4th, 1890, and to those journals, financial and otherwise, together with a Queen Victoria Street firm of electrical engineers, who thought okonite "a good thing," we specially commend its careful re-perusal.

The Electric Light at Bournemouth.—The Bournemouth Town Council, at the last week's meeting, adopted the report of the General Purposes Committee, recommending that they should invite schemes for lighting the pier and the central pleasure gardens by electricity. Permission was also given to the Bournemouth and District Electric Supply Company, Limited, to place temporary overhead wires (their underground system not being yet completed) for the purpose of lighting Holy Trinity Church and the new Congregational Church.

Killed at the Lauffen Station.—On Monday afternoon Mr. Rau, an assistant at the Lauffen generating station, was killed. He was found lying lifeless on the floor of the transformer house by the managing engineer, who had just noticed variations in the registering apparatus. The deceased entered the transformer house while the plant was in operation, probably to look to a faulty lamp. This was against the written instructions, and the lamp could have been attended to on shutting down. He was in the employ of the Oerlikon Engineering Works, and his death is said to have been caused by receiving a shock from a wire through which the high-tension current was passing. Efforts to restore animation were of no avail.

A New Telegraph Machine.—A telegram from Berlin states that a new telegraphic transmitting machine has been invented by Herr Jaite, Director of Telegraphs. In the apparatus there are two electro-magnets, the one worked by a positive and the other by a negative current. These set in motion a perforator, whereby holes are punched in a tape. The holes, instead of consisting of mere dots and dashes, as in the Morse system, are so arranged that, on joining them with lines, the letters of the Roman alphabet are formed. The chief merit of the machine, says the report, is the extraordinary ease with which it can be worked. At a recent trial between the Berlin and Hamburg Stock Exchanges, a distance of nearly 200 miles, it was found possible to send from 65 to 85 messages per hour, or from 25 to 35 words per minute. It is declared that the public will easily learn how to decipher the perforated tape, and will, in time, be able even to perforate their own messages and hand them to the telegraph officials for immediate transmission. Further details will be looked for with interest, but the idea does not seem at first sight to be a very promising one.

Rhondda and Swansea Bay Railway.—The directors of the Rhondda and Swansea Bay Railway have obtained a report from Messrs. Morgan Williams and King, on the question of the electric lighting of a two-mile tunnel, and also of the passenger trains. It is proposed to utilise water-power for generating the current.

American Electrical Industries and the Census.—Probably there is no undertaking in which American citizens are more interested than in the electrical industries, and our American contemporary, *Western Electrician*, writing on the subject, states that the interest evinced by statistics concerning this particular line of industry is not by any means confined merely to those actively engaged in the manufacture or operation of apparatus. Mr. A. R. Foote, of the Electrical Department of the Census Office, states that nineteen schedules and supplements have been prepared, and extensive arrangements are being made for the collection of statistics regarding the electrical industries for the eleventh census.

The Blake Patent in Great Britain.—Our namesake, the *Electrical Review*, of New York, published recently the following letter, which had been received from a Boston correspondent in reply to another letter which previously appeared in our contemporary :—"Your Boston correspondent, 'W. I. B.,' says, 'Bell and Blake patents having lapsed in Great Britain and Canada, opens up the telephone field in those countries to active competition,' &c. In the interest of accuracy, I desire to state, with respect to the Blake patent in Great Britain, that your correspondent is misinformed The Blake patent in Great Britain does not expire until January 20th, 1893."

The Electrolysis of Metallic Phosphates. — The metallic phosphates form an important group of substances which, during the past few years, have received considerable attention in America from Mr. E. F. Smith, also from Mr. Moon. Some metals that are closely allied to each other in chemical and physical properties are exceedingly difficult to separate ; hence it is often hard to obtain some of them in a pure state ; but again this property is not an altogether unmixed disadvantage, for it has undoubtedly led to the discovery of some valuable alloys, in which mere traces of foreign metals are found sometimes to have conferred valuable qualities. Much of Mr. Smith's work may be found in the American scientific journals, and there is an important paper in the current issue of the *American Journal of Chemistry*, in which platinum, gold, and other more or less important metals are dealt with. The plan adopted is to electrolyse the phosphates in acid solution, and there is some information given as to the condition of the various metals deposited. For details, consult the journal, vi., p. 206.

The Solubility of Zinc in Dilute Acids.—The slight solubility of chemically pure zinc in dilute acids is usually explained by supposing that the solution of impure zinc is in reality due to the electric currents set up by the contact of the zinc with the impurities, and that, as in pure zinc, no such currents can occur, it remains undissolved. This theory, however, does not account for the solubility of the pure metal in nitric acid, or even in dilute sulphuric or hydrochloric acid at their boiling points. In order to clear up this difficulty, J. M. Weesen has been investigating it experimentally, and as the result of his research he finds that the insolubility of the chemically pure zinc is due simply to the formation of a condensed layer of hydrogen gas upon the surface, which then prevents the further action of the acid. In the case of nitric acid, the condensed layer of hydrogen is oxidised by the acid as it forms, and cannot protect the surface of the metal, whilst in the case of impure zinc the hydrogen is evolved from the surface of the more electro-positive impurities according to the usual law, thus leaving the surface of the zinc exposed to the action of the acid. Herr Weesen has a paper of considerable length in the *Berichte* on this subject, in which those who are interested may read of the method pursued in his experiments (*vide Berichte*, xxiv., pages 1,785—1,798) which were carried out with other metals besides zinc, *e.g.*, iron, aluminium, &c.

Bombay and Electric Lighting.—A meeting of the Bombay Municipal Corporation was held a few weeks back when the question of electric lighting was freely discussed. It was stated that the contract with the gas company would expire in fifteen months or so, and it was very desirable that some better means of lighting the city should be obtained. It was proposed to give the electric lighting a fair trial, at first as an experiment, and if this proved satisfactory the light would be adopted permanently ; but finally, the consideration of the question had to be postponed pending the settlement of several other matters of importance.

How Iron may be Separated from Nickel and Cobalt by Electrolysis.—So closely allied in many of their properties are the metals iron, nickel and cobalt, that great difficulty is experienced in separating them when they happen to occur together. This difficulty is, however, dealt with in a new method of separation recently proposed by G. A. Le Roy. The solution containing these metals and also manganese, is mixed with a large excess of concentrated and strongly ammoniacal solution of ammonium sulphate after the addition of sufficient citric or other acid to prevent precipitation of the metals. The solution is then electrolysed with the current from two Bunsen cells (or their equivalent) ; manganese separates at the anode, and iron, cobalt and nickel at the cathode. The cathode is washed, and is then put into a concentrated solution of ammonium sulphate saturated with ammonia. It now serves as the anode, a weighed platinum plate being the cathode : and when the circuit is closed, the nickel and cobalt are transferred to the new cathode, whilst ferric hydroxide partly remains on the anode and partly floats in the liquid, but it is free from any appreciable traces of nickel or cobalt.

NEW COMPANIES REGISTERED.

British Electric Installation Contractors, Limited.—Capital, £20,000 in £5 shares. Objects : to carry on the business of an electric lighting company in all its branches in the United Kingdom, to construct, execute, lay down, fix, maintain, and repair such buildings, mains, wires, cables, accumulators, as may be found necessary for the electric lighting of streets and houses, and the production of electricity and electrical energy. Signatories (with one share each) John Millington ; J. Duce, 1, Angel Street ; A. H. Parker ; W. H. Walter ; S. T. Castle ; H. Webb, 1, Angel Street, and H. A. Leicester, all of Worcester. The number of directors is not to be less than three nor more than seven, the first to be appointed by the subscribers. Qualification : shares to the amount of £125. Remuneration as fixed by the company. Registered on the 12th inst., by Messrs. Waterlow Bros. & Layton, Limited, 24 and 25, Birchin Lane, E.C.

"Vulcan" Engine Company, Limited. — Capital, £3,000 in £1 shares. Objects : to enter into an agreement dated October 7th, 1891, between E. W. Field of the one part, and W. Jenks of the other part, to acquire and carry on the business of the said E. W. Field, and to carry on the business of an engineer and contractor, of a millwright, smelter, brass, iron, and metal founder, and of an electrician, an electric light contractor, dynamo manufacturer, &c. Signatories (with one share each) H. Musgrove, 15, Cullum Street, E.C. ; E. Goddard, Ferndale, Kimberley Road, Nunhead ; F. J. Prior, Finsbury Park ; E. W. Field, 52, Bedford Road, Reading ; A Harding, 36, Lowman Road, Holloway ; W. Jenks, 41, Tonsley Place, Wandsworth ; A. H, Dee, 17, Grayshott Road, Lavender Hill, S.W. Edward W. Field is the managing director with a salary of £12 per month. Registered on the 12th inst., by G. Tilling, Devonshire Chambers, Bishopsgate.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Installation and Maintenance Company, Limited.—An agreement of August 13th, 1891 (filed October 6th), between J. E. H. Gordon and Company, Limited, and the above company, provides for the building

of certain works at Sydenham for the supply of electricity to the exhibitors at the forthcoming exhibition at the Crystal Palace, and also for the supply of electric light to the neighbourhood, by the contractors (J. E. H. Gordon and Company, Limited), for the sum of £51,175, and an agreement of the 13th ult. (filed on the 6th inst.) between the same parties, alters certain payments as described in the above agreement. Office, 4, Great Winchester Street, E.C.

W. T. Henley's Telegraph Works Company, Limited.—Special resolutions that the capital of the company be increased to £100,000 by the creation of 3,000 new 7 per cent. preference shares of £10 each were duly passed at an extraordinary general meeting of the above company, held at Cannon Street Hotel on the 1st ult., and confirmed at a similar meeting held at the company's offices, 27, Martin's Lane, E.C., on the 18th ult., and accounts were filed on the 1st inst.

Electrical Supplies and Fittings Company, Limited.—The registered offices of this company have been removed from 15, St. Helen's Place, Bishopsgate Street, E.C., to Faraday House, Charing Cross Road, W.C.

National Electric Supply Company, Limited.—The offices of this company have been removed to Victoria Buildings, Preston. (Filed 9th inst.)

CITY NOTES.

The City of London Electric Lighting Company, Limited.

THE first ordinary general meeting of this company, being the statutory meeting required to be held four months after the registration of the company, was held yesterday at Winchester House, Old Broad Street.

The SECRETARY having read the notice convening the meeting,

The CHAIRMAN (Sir David Salomons) made a few remark regarding the history of the company. He referred to the provisional orders granted, and confirmed by Parliament, for the eastern, western, and central districts to be lit by two companies, one being the Brush Company, taking over the eastern and western district, and Laing, Wharton and Down for the central. He stated that nothing had yet been done in the western district, in consequence of this order having been granted considerably later than the others. The central and eastern districts were those upon which they intended to work. The orders would have fallen through, and the whole of the labours of obtaining those orders would have been rendered valueless, had it not been for the Pioneer Company. That company was first started, and breathing time being allowed for the formation of a larger one. Now the City of London Pioneer Company, under certain contracts, sold the whole of their risks to the present one, and hence their position at present. It was only on August 21st that they obtained the sanction that they required for the transfer of the company's powers to themselves from the Board of Trade, and also they had to have the assent of some of those for whom they were contracting, *i.e.*, the Commissioners of Sewers in the City, and others. When they went to business it was their intention to keep everything open, and to do nothing under-handed, and to do all so that it would not require to be done a second time. Supposing 80 per cent. of the lamps supplied are to be alight at one time, the final equipment would be for 400,000 8-candle-power lamps for private purposes. The underground work was found extremely difficult, considering the large number of other mains and telephone wires, &c., which were below the ground in the City of London. This, he stated, would make the expenses considerably heavier than in country places. He thought it necessary to point this out, as comparisons would doubtless be made later on, and the expense would be considered as excessive, but should they appear larger than the laying of conductors in other districts, it was entirely due to these difficulties that there are not subways throughout the City. There were to be no transformers in the houses which were to be lighted by electricity. At the head station there would be a high pressure current delivering about 2,000 volts, which was not an unreasonable pressure, as it had been tried elsewhere. The work would be part on the Brush system and part on the Thomson-Houston system. In Queen Victoria Street, 26 arc lights were at work, but as the lamp-posts had not yet been passed by the City engineer, they could not proceed with that work until it was absolutely settled. They had already received, roughly speaking, 200 applications, and, assuming from the sizes of the buildings and offices which had applied for the lighting, they estimated that 40,000 lamps would be required for these alone. Amongst others, they had applications from the Post Office, Mansion House, Guildhall, banks, offices, and such like, so that large concerns already seemed to have faith in them. He hoped the private lighting would be ready, on a small scale, by the end of the year, but he would not like to say for certain. In consequence of the economies of the Pioneer Company in the expenses incurred in issuing this company, an extra sum of £6,000 was placed to their credit. The board had done some good work at their afternoon meeting. The final order which they had forwarded was for the wiring of all the chief districts round Queen Victoria Street, and other streets close by, and by the end of next year it was hoped that the greater part, if not the whole, of the public lighting would be completed, and bring in a very considerable revenue. The work was progressing, and it was simply a question of patience. They had Prof. Silvanus Thompson as their consulting electrician, and he settled all their uncertain points. He then stated that everything was ready to obtain a quotation on the Stock Exchange, but there was one thing which required remedying, and that was embodied in the following resolution, which was moved by Mr. W. W. Bruce:—"That Article No. 13 of the company's articles of association be altered by inserting after the words 'each call' at the end of the fourth line the following:—'And that no call shall exceed one-fifth of the nominal amount of a share, or be made payable within two months after the last preceding call was payable.'"

This was seconded by Mr. JOHN MORRIS, and carried unanimously. The proceedings then terminated.

The International Okonite Company, Limited.

THE directors' first annual report, which was presented at the ordinary general meeting, held on Wednesday last, reads as follows:—The accounts of the company are made up from January 1st, 1890, to June 30th, 1891, a period of 18 months; the American accounts are, however, made up to May 31st, 1891, and therefore cover a period of 17 months only. After deducting ample depreciation and making provision for the interest on debentures, there is a credit balance of £39,465 7s. 2d. This includes the profit earned from January 1st, 1890, to the date of the registration of the company, viz., £21,711 1s., which sum, not being available for distribution, the directors have written off patent and goodwill account.

Up to the end of the year 1890 the business was progressive and satisfactory, and the interim dividend then declared was justified by the business done. Since that time the company has suffered from the results of the severe crisis which took place in the United States in all electrical, engineering and kindred industries, and which culminated in the failure of the Westinghouse Company. In addition, through the operations of speculators during the latter part of 1890, rubber, which is one of the principal raw products used by the company, was maintained at an abnormally high price, whereby the profits have been seriously affected. Copper also stood at an advanced price.

The interim dividend paid in January on the preference and ordinary shares has absorbed £10,694 19s., leaving a balance of £7,059 7s. 2d. to be now dealt with. The directors recommend the payment of a further dividend of 4 per cent. on the paid up preference share capital for the half-year ending June 30th, 1891, making 8 per cent. for the year. This will amount to £6,800, leaving a sum of £259 7s. 2d., which it is proposed to apply to reduction of preliminary expenses.

The directors are pleased to state that there has been a marked revival in the electrical trades since the period covered by the accounts, from which revival the business has already benefited. The sales have been larger in the months of July and August than in any of the preceding months of the present year, and it is confidently anticipated that the company will benefit from the general improvement of American industries. Moreover, since the failure of the speculation before referred to, India-rubber has fallen to its ordinary price, while copper is also lower. The directors, therefore, have every confidence in the immediate prospects of the company. They are thoroughly satisfied with the progress made in England, and, now that the new works are complete, they anticipate a considerable increase of business in the immediate future.

It has been considered desirable that the company should be in a position to carry out in its own works every process connected with the manufacture of all kinds of insulated wire. The directors have, therefore, erected additional buildings and machinery at the Passaic Works, which are now complete in every particular. This has necessitated a larger capital expenditure than was originally contemplated, but results have shown that the company will in the future derive great benefit from these extensions.

In England the growth of the business has justified the directors in acquiring the freehold of the factory at Manchester, originally held on short lease. The new buildings are now finished, and the factory is one of the largest and most complete of its kind, and is fitted with machinery and plant of the most approved pattern for the manufacture of every class of insulated wire or cable at present in use, including okonite, vulcanised rubber, gutta-percha and compound covered. A well-fitted machine shop has also been provided for the manufacture of the special machinery required for making okonite wire.

Okonite insulation has been proved to stand extremes of heat and cold in a very remarkable manner, and to be less liable to perish, either from natural causes or rough usage, than the ordinary forms of rubber-covered conductors. The directors look forward to its extensive use where high electrical resistance is required, and they consider the present time most favourable for its introduction into this country. It is expected that the manufacture of this speciality of the company's products will commence at Manchester before the date of the general meeting.

The works and plant conveyed to the company have been maintained in an efficient state. It is the custom in most American works to charge repairs to machinery (including all replacements) to revenue account, and this has been done at the Passaic Factory. In Manchester, owing to the entire re-arrangement of the processes, nearly the whole of the machinery has been moved, and before re-erection, been thoroughly overhauled and put in high class condition. To secure uniformity of practice, the cost has also been charged to revenue account. This, although reducing the immediate profits, places the company in a most stable position, as proper and customary depreciations have, in addition, been allowed for in the accounts.

In view of the disappointing results of the trading of the company, the directors and managers in England have decided not to take the percentages of net profit to which they are entitled under the articles of association and their agreements, amounting to £392 15s. 9d. and they propose that this amount shall be postponed until such times as the net earnings of the company show a substantial improvement.

General Sir William G. Davies, K.C.S.I., having resigned, the directors (in accordance with clause 95 of the articles of association) elected Mr. John Henry Tod (Tod, Durant & Co.), 3, Crosby Square, London, E.C., in his place, and they hope this appointment will meet with the approval of the shareholders.

The auditors, Messrs. Price, Waterhouse & Co., retire, and being eligible, offer themselves for re-election, which the directors recommend.

The first ordinary general meeting of this company was held on Wednesday last at Cannon Street.

The Chairman (Lord Greville) was unable to attend, owing to his being in Ireland suffering from an attack of the gout. Mr. Samuel Pope, Q.C. (vice-chairman), therefore presided.

The SECRETARY having read the notice convening the meeting, the report and accounts were taken as read.

The CHAIRMAN stated that there was not much to say which was not already embodied in the report. He pointed out, by way of additional emphasis, two or three of the considerations which had weighed with the directors in the preparation and presentation of the report. Of course, the fact that they were unable to recommend the declaration of a further dividend upon the ordinary shares of the company was not so satisfactory as one would desire it to be (No! no! certainly not); but they had to bear in mind that even with that disadvantage, and in a year of very extraordinary pressure as regards industrial enterprises, the ordinary stock of the company would have received 5 per cent. for their year's investment. That which had weighed with the directors in the recommendation which was included in the report, was that they regarded the management of an industrial enterprise such as theirs as desirable to be maintained, with a view to the permanent stability of the enterprise, rather than with the view to the temporary value of the shares which the shareholders held. Of course they were entirely aware that to those who desired to realise their shares, the declaration of a dividend was a very convenient matter; but to those who were investors in the undertaking, it appeared to the board to be far better not to declare a dividend in anticipation of future profits, but simply to take the strict and legal course of confining the amount distributed to the amount actually earned, although it might not have the effect of increasing the value of the shares to which it was allotted. The board were unanimous that it ought to be managed without any "dodging" of accounts for the purpose of giving a dividend, but the actual results of the year's trading should be honestly placed before the shareholders, and only that amount of profit which had been earned by the period covered by the accounts. He thought that in the shareholders judgment, was the true principle upon which an industrial undertaking like that of this company should be carried out. There was abundant indication of the stability and value of the property, of which they were the proprietors, in the report. Of course they would bear in mind the special circumstances which attached to the first statement of accounts presented to the shareholders. It included, in the first place, the profits purchased by the company, which accrued from January 1st to June, 1890, an amount of £21,711, which, of course, being profits earned by the company before its registration, was not a sum which could be legally distributed or divided. The directors, therefore, recommended that, as they could not divide it, it should be used, so to speak, in the reduction of the purchase, so as to diminish the capital responsibilities of the company. Further, in the accounts which had been presented, the American accounts were made up only to May 31st, 1891. The English accounts covered the period to June, 1891. The reason for this was that, for the convenience of an early presentment of accounts to the shareholders in future, it had been thought desirable that the American stocktaking, which had hitherto been a somewhat tedious and lengthy operation, should go a month behind the English stocktaking, which was not so difficult to deal with. Thus they had, as regards the American concern, to account for a month's less profit than they would have had in any subsequent year, and the advantage which that, in ordinary circumstances, would give them, had been acquired by the board in the present year. Several practical reforms had been now accomplished, and in future they hoped to hold the general meeting and present the accounts at an earlier period than they had been able to do in the present year. If they had included in the accounts the month of June for the American business the profits would have been increased to the extent of several thousands of pounds, and, of course, if that had been done, it might have enabled them to pay a dividend upon the present ordinary shares, but the accounts as presented were those upon which the dividend had to be agreed, and he hoped that the ordinary shareholders would receive the benefit of their abstinence from the dividend at the month of June. They must also bear in mind that this in common with all industrial undertakings, especially in America, the last nine months, or perhaps the nine months between September and June of 1890 and 1891, was a time of extraordinary pressure and very great difficulty. The Chairman corrected what he thought was too strong an expression with reference to the Westinghouse Company. The report referred to the company's failure, but it was too strong a term to apply to the undertaking which had been merely re-organised, and might become a prosperous concern in the future. A revival had, however, now set in, and they were already receiving the benefit of that revival, not merely in England, but in the American business also, their English works were now engaged in the production of their speciality, the okonite wire, and they anticipated, therefore, very considerable increase in their English business, and the panic seemed to be at an end. The business for the four months since, for instance, was several thousand dollars in excess of the January to May, which was the termination of the accounts. There was abundant evidence that the business itself was healthy and profitable, and that when they met the shareholders again, unless some unforeseen misfortune happened, the meeting would be much more satisfactory than the present one. Their Manchester business had been very much curtailed and hampered by the fact that they had been compelled to remove their machinery to arrange to carry on the manufacture of their okonite speciality. That was all completed, and the business was in first-rate working order. Mr. Shaw, who represented them there, would be able to assure the shareholders that there was every prospect of a thoroughly satisfactory English business there, which was not so subject to fluctuations and to causes of depreciation as on the other side of the Atlantic. In the course of his remarks the chairman said that the most cordial co-operation prevailed, not only with the board in England, but between the members of the American committee of management. The hopes he expressed were unanimously entertained by every member of the board. He then formally moved the adoption of the report, which was seconded by Sir Alexander Armstrong, K.C.B., F.R.S.

Mr. SQUIRE (a shareholder) then referred to several items in the report, about which he wished to have further explanation.

Mr. PETERS also asked several questions, and stated that he thought it would be merely courtesy on the part of the board if they gave a fuller trading account.

A discussion ensued, in the course of which dissatisfaction was expressed by several speakers that the shareholders were not clearly informed in the prospectus that the sum of £21,000, referred to by the chairman, was not divisible.

The CHAIRMAN, in replying, said that upon some matters, as, for instance, the question of the profits derived from the trading, the directors did not think that it would be advisable to make that statement public, because it was a statement which might be made available for the purposes of their competitors or their customers, and cut down their profits where they might appear to them exorbitant and unreasonable. That was the only reason why they did not publish the details of their trading; but if any shareholder desired any information, he might obtain it by calling at the offices of the managing directors, who would be very glad to give any information, but the directors desired that the intimate nature of the business should as far as possible be confined to their own knowledge.

A question was asked as to when the Manchester department would be in full working order, and the chairman stated that it was in full working order at the present moment, and the okonite samples were before the customers, and they expected to have orders almost immediately. The capital expenditure was complete upon the Manchester works, and they had been commenced within the last fortnight, and they were receiving a considerable increase in orders over any previous year. They were endeavouring to introduce their okonite into all possible forms of consumption, but he believed he was right in saying that electricians preferred gutta-percha to any other similar substance.

Mr. A. VAUGHAN-STEVENS (the managing director) stated that they were now on the list of the contractors for the Admiralty, which was a very important consideration. It would also follow with the War Office, and before they could get on these lists their works had to be examined by an inspector sent down for the purpose, and the Government would not allow them to contract unless they were in a position to do so well, and at the same time to deliver expeditiously. He (Mr. Stevens) had been to America twice since they took over the business, and found the business there admirably managed. He thought they had every prospect of being the first company with one exception. The progress of the business in England he believed was highly satisfactory, as month by month their sales from the English factory were increasing.

Mr. JOHN SHAW, one of the managers at the Manchester works, also gave further information regarding the working and progress of the company. In the course of his remarks he stated that since June they were steadily increasing their turnover, the month of September being 30 per cent. in excess of what it was in 1890, and October was better still.

The resolution "that the report and accounts be received and adopted" was carried without any dissentients.

The CHAIRMAN stated that the preference share dividends of 8 per cent. would be paid in a week or ten days, as it would be necessary to make arrangements for simultaneous paying in America and England.

The re-election of Messrs. Price, Waterhouse & Co., as auditors to the company at the same remuneration as before, and a vote of thanks to the chairman terminated the proceedings.

The Brazilian Submarine Telegraph Company, Limited.

THE directors' report for the half-year ended June 30th, 1891, to be submitted to the 36th ordinary general meeting, to be held on the 21st inst., states that the revenue for this period amounted to £158,905 3s. 1d., and the working expenses to £25,449 5s. This very exceptionally increased revenue mainly arises from the disturbed state of affairs in South America. After providing £12,880 for debenture interest and sinking funds, and £2,320 2s. 9d. for income tax, there remains a balance of £118,255 15s. 4d.; to this is added the sum of £11,121 4s. received in respect of traffic receipts between March, 1889, and December, 1890, hitherto under dispute, and £23,833 17s. 5d. brought forward from December 31st last, making a total of

£153,210 16s. 9d. A quarterly interim dividend amounting to £32,500 has been paid, and £60,000 transferred to the reserve fund, increasing that fund to £474,878 7s.

The directors now recommend the declaration of a final dividend of 1s. per share, making with the interim dividends a total dividend of 6 per cent. for the year, and also the payment of a bonus of 4s. per share, both free of income tax, which together will amount to £32,500, leaving a balance of £28,210 16s. 9d. to be carried forward. The dividend and bonus will be payable on the 22nd inst.

On July 31st last the sum of £16,000 was transferred to pay off the 160 bonds of the 1884 issue, drawn for redemption in April last. This repayment reduces the debenture debt to £128,200.

The receipts for the half-year include the sum of £1,500 dividend to December 31st, 1890, on the company's shares in the African Direct Telegraph Company, Limited.

An interruption occurred on August 11th last in the 1874 cable of the St. Vincent-Pernambuco section, about 50 miles from the coast of Brazil. By arrangement with the Eastern Telegraph Company that company's ss. *Mirror* was sent out, and a repair effected on September 17th. A fault was also cut out of the same cable, the tests of which are now highly satisfactory.

The directors have made arrangements for applying the duplex system of working to the three sections of the No 2 cable, whereby its power of transmission will be greatly increased.

The various sections of the company's line are in good working order.

The Hon. W. St. John F. Brodrick, M.P., and Lord Sackville A. Cecil retire by rotation at this meeting, and, being eligible for re-election as directors, offer themselves accordingly.

The auditors, Mr. Henry Dever and Mr. John Gane, also offer themselves for re-election.

Electric Arms and Ammunition Syndicate.

The report of the directors to the shareholders in this syndicate for the past year states that:—

In July last the system appeared to be sufficiently complete to warrant its trial in public, and the board had a number of rifles constructed on the syndicate's system of electrical discharge. This trial was made at the annual meeting of the National Rifle Association at Bisley, where a competition was organised for prizes offered by the syndicate. The competition attracted many of the most famous rifle shots of the country, and was completely successful. Several eminent gun and rifle manufacturers expressed their great interest in the syndicate's system, and were very favourably impressed with it; their opinions were such as to encourage the board in the belief that there is a good future for any company or person that can perfect a system of electrical discharge for explosives used in heavy ordnance and small arms.

The result of this competition, while demonstrating in a satisfactory manner the feasibility of electrical discharge in small arms, developed a defect in the battery used for generating the electric current, necessitating further experiments, which showed that the defect was in the mechanical construction of the battery cases, and not in the principle of the battery.

These experiments did not enable the board to overcome the defect, and it became necessary to call in the aid of experts to advise the board on other methods of mechanical construction. After many months occupied in experiments and researches, a new battery has been produced, which appears likely to answer fully the requirements of the syndicate's system, it having given satisfactory results after being submitted to a long series of tests by an eminent scientific man; but inasmuch as it is necessary that these tests should be extended over a lengthened period, the board has not yet received his final report. The special test now being applied to the new battery is with a view of showing how it will stand under exposure to high temperatures: this test cannot be concluded for some little time.

The behaviour of the battery under the test already applied is, however, sufficiently encouraging to justify the board in persevering with these experiments, believing as they do that it will prove suitable to the requirements of the system, which—the battery difficulty once overcome—will then be perfected and available for practical use. To meet the necessary expense the board has made a further call of £20 per share.

The first ordinary general meeting of the Electric Arms and Ammunition Syndicate, Limited, was held on Friday last at Winchester House.

Major Waller presided, and in moving the adoption of the report, observed that they met in rather exceptional circumstances, a petition having been presented by five of their shareholders to the court for the compulsory winding up of the syndicate. The board had opposed the petition in the interests of the shareholders generally, feeling that there should be no liquidation until, at any rate, the general body of them had had an opportunity of expressing their views on such a course. With the exception of two or three shareholders outside of those who had presented the petition, the directors were supported by the whole body. The first hearing of the petition was on the 30th ult., when the judge ordered it to stand over until after their meeting that day, so that he might hear at the adjournment what might be the feeling of the shareholders. The chairman then referred to the trial at the annual meeting of the National Rifle Association at Bisley of the syndicate's system of electrical discharge. They proposed to call the shareholders together again in about three months' time, and not to make any other call without consulting the shareholders first.

Colonel Ernest Villiers seconded the motion, which, at the suggestion of Mr. E. M. Underdown, Q.C., was altered as follows:—"That the report and accounts be received and adopted, and the business of the syndicate be continued."

Mr. Watson, sen., expressed doubts as to the feasibility of the syndicate's system of electrical discharge, having heard that at the meeting at Bisley there were very numerous miss-fires.

Captain Pixley, on the other hand, stated that he had fired several shots at Bisley, and had not had a single miss-fire.

Mr. Pooley read a letter which he had received from a firm of gunmakers, who, he said, expressed their opinion that the invention could only be used for toy purposes. He moved an amendment, in effect rejecting the report and accounts, and confirming the course taken in presenting the petition, but the motion was lost and the original motion was then declared carried by six votes to four.

Major Waller was subsequently re-elected to his seat as chairman.

On Wednesday last, 14th inst., the petition was again presented to the vacation judge, but under special circumstances the petition was ordered to stand over.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.

Report of the directors for the half-year ended June 30th, 1891, to be submitted to the thirty-sixth ordinary general meeting, October 21st, 1891:—

The gross receipts, including Government subsidies, have amounted during that period to £264,878 6s. 11d., against £254,856 18s. 10d. for the corresponding half-year of 1890.

The working expenses, including £17,318 5s. 11d. for cost of repairs to cables and expenses of ships, absorb £71,476 15s. 8d., against £76,670 9s. 3d. for the corresponding period of 1890, leaving a balance of £193,401 11s. 3d. From this is deducted £2,981 17s. 1d. for income tax, £33,074 14s. 5d. for interest on debentures, debenture stock, and contribution to sinking fund, and £2,179 10s. 2d. for special expenditure as shown in the revenue account, leaving £155,165 9s. 7d. as the net profit for the half-year.

One quarterly interim dividend of 1¼ per cent., amounting to £31,250, has been paid during the half-year, and another of like amount will be distributed on the 15th inst., leaving £92,665 9s. 7d. to be carried forward.

All the 6 per cent. debentures that were outstanding when the last report was issued have been paid off and cancelled, and the Stock Exchange have granted an official quotation in the new 4 per cent. debenture stock, which now stands in the market at a considerable premium.

It is with deep regret that your directors have to record the death, on the 12th ult., of their much esteemed colleague, Sir Thomas Fairbairn, Bart., who had been associated with the company from its inception. It is not proposed to fill the vacancy in the directorate thus occasioned.

As, however, Sir Thomas Fairbairn was also one of the trustees for the 5 per cent. Australian subsidy debenture holders, it has been deemed advisable to appoint a new trustee, and Mr. John Denison Pender has undertaken to act in this capacity.

The guarantee arrangement made with certain of the Australasian colonies for testing the effect of a 4s. rate to Australia came into operation on May 1st last, and the increase of traffic resulting from the reduction of tariff is so far encouraging. As, however, the accounts embrace only two months' receipts at the reduced tariff, it is too early to form any reliable opinion as to the result of this important experiment.

In accordance with the arrangements entered into with the Indian Government, the company's station at Elephant Point (Rangoon) has been closed, and a considerable portion of the cable between Elephant Point and Penang picked up and utilised elsewhere.

An arrangement has been concluded with the Dutch Government for connecting by submarine cable Sumatra with Penang, so as to bring the Netherlands' Indian Government telegraphs into direct communication with the company's system at Penang. The cable for this purpose will be taken from the company's depôt at Singapore, and laid in the course of the next few months.

The Direct United States Cable Company, Limited.—The Board of the Direct United States Cable Company, Limited, have resolved upon the payment of an interim dividend of three shillings and sixpence per share, free of income tax, being at the rate of 3½ per cent per annum, for the quarter ending September 30th, 1891; such dividend to be payable on and after the 24th instant.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended October 9th, amounted to £4,901.

The City and South London Railway Company. Traffic receipts for last week amounted to £747.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 9th, 1891, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Company were £3,797.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Oct. 8th.)	Closing Quotation. (Oct. 15th, 1891.)	Business done during week ending (Oct. 15th, 1891.) Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 —102	99 —102	...	...
1,300,980*l*	Anglo-American Telegraph, Limited	Stock	48½— 49½	48 — 49 xd	49¼	49
2,849,510*l*	Do. do. 6 p. c. Preferred	Stock	87½— 88½	86½— 87½xd	88	86⅜
2,849,510*l*	Do. do. Deferred	Stock	12¾— 13¼	12¾— 13¼	13⅜	12⅞
130,000	Brazilian Submarine Telegraph, Limited	10	12 — 12½	12 — 12⅜	12⅜	12
53,200*l*	Do. do. 5 p. c. Bonds	100	99 —102	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978*l*	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅛— 3⅜	3⅛— 3⅜	3⅜	3
69,996*l*	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	1⅞— 2⅛	1⅞— 2⅛	2⅛	1⅞
50,000	City and South London Railway, Nos. 1 to 50,000	10	2 — 4	2 — 4	3½	...
$7,716,000	Commercial Cable, Capital Stock	$100	122 —124 xd	125 —130	127	125
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	7/16— 9/16	7/16— 9/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	5 — 5⅛	5 — 5⅛	5 5/16	5⅛
16,000	Cuba Telegraph, Limited	10	10 — 11	10 — 11	11	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3½— 4 xd	3½— 4	...	...
6,000	Do. do. 10 p. c. Preference	5	9½— 10½xd	9½— 10½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11 — 11¼	10⅞— 11⅛xd	11 3/16	10⅞
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅛— 14½	14⅛— 14⅜xd	14½	14⅛
70,000	Do. 6 p. c. Preference	10	15 — 15⅛	14¾— 15⅛xd	15⅛	15⅛
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	107 —110	107 —110	108½	108¼
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅞— 15⅛	14⅞— 15⅛xd	15¼	15
78,300*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	104 —107	104 —107	...	...
276,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	104 —107	104 —107	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	106 —109	106 —109	108½	...
135,000*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	102 —105	102 —105	...	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	103	102¼
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	7½— 8	6⅞— 7¼	8⅛	6⅞
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ..	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅞— 3⅛	2⅛— 2⅜	2⅜	2 1/16
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3⅝— 4⅛	3⅛— 3⅜	3 5/16	3⅛
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	2¼— 2½	1⅞— 2⅛	2⅛	1 15/16
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜— 10	9⅝— 9¾xd	9 15/16	9⅜
180,042	Do. do. 6 p. c. Preference	10	14⅞— 15⅛	14⅜— 15xd	15⅛	14 13/16
150,000	Great Northern Tel. Company of Copenhagen	10	18⅜— 19¼	18⅜— 19¼	19⅛	18⅝
220,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	104 —107	105 —108	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 466*l* to 14,000 ...	10	8 — 8½	8 — 8½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	10 — 11	10 — 11	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ...	10	20 — 21	20 — 21	20¼	...
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000 ...	10	7 — 8	7 — 8	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	9 — 9½	8¾— 9¼	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6½— 7½	6½— 7½	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	9⅜— 10¼	9⅜— 10¼	10¼	9 15/16
447,234*l*	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 4⅝	4¼— 4½	4 9/16	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13	12½— 13	12 15/16	12⅝
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 13	12 — 13	...	...
420,000*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	105 —107	105 —107	106½	106
6,318*l*	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	3½— 4½	3½— 4¼	...	...
220,000*l*	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	1/16— 3/16	1/16— 3/16	...	...
9,000*l*	Reuter's Limited	8	8 — 8½	8 — 8½	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅜— 8¼	7⅜— 8¼	8½	7 15/16
7,900	Do. do. do. 7 per cent. pref.	2	6¾— 7¼	7 — 7¼	7¼	7 1/16
3,381	Submarine Cables Trust	Cert.	120 —125	118 —123	120	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	5 — 5½	5 — 5½	5½	5 1/16
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	42½	...
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1894	100	102 —105	102 —105	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	2 — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
3,200*l*	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7½— 8½	7½— 8½	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	97 —100	97 — 100	99½	...
30,000	West Coast of America Telegraph, Limited	10	3½— 4	3½— 4	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	98 — 103	98 —103	...	...
67,007*l*	Western and Brazilian Telegraph, Limited	15	10⅜— 11¼	10⅜— 11¼	11⅛	11
30,364*l*	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	7	...
30,364*l*	Do. do. do. 5 p. c. Deferred	7½	4½— 5	4¼— 4⅝	4⅝	4⅜
189,700*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	102 —105	103 —106	105¾	105
237,200*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	102 —105	103 —106	...	...
88,321	West India and Panama Telegraph, Limited	10	1¼— 1½	1⅛— 1⅜	1⅜	1⅛
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9¼— 9⅝	8⅞— 9¼	9½	9
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	8 — 9	7½— 8½	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
173,100*l*	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
42,853	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5⅞—6⅛	5⅞— 6⅛	5⅞	...

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting (Pioneer), Shares of £50, fully paid, 60—62.—Ordinary of £10 each, £4 paid, 4⅛—4⅜.—Electric and General Investment, Shares of £5, £1 paid, 1⅜—2¼.—Elmore's Austrian Copper Depositing, 15s., 25s., £2 share issued at 10s. prem. fully paid, 1—1¼.—Elmore's Priorities, 3⅜—4⅛.—House to House Company (£5 paid) 4½—5.—Liverpool Electric Supply, Shares of £5, £3 paid, 4⅞—5⅛.—London Electric Supply Corporation, Ordinary (£5 paid), 1⅞—2⅛.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅜ — ⅝.—National Telephone Debentures, 2½ — 3 prem. —Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2⅛—2⅜.—£5 Preference, fully paid 3⅜—4.—Debentures 90—95.—Wards Electric Car, £10 paid, ⅜—1.

BANK RATE OF DISCOUNT.—3 per cent. (September 24th, 1891).

NEW PATENTS—1891.

16,388. "An arc lamp." W. S. HAYS. Dated September 28th. (*Complete.*)

16,407. "Improvements in printing telegraphs." H. J. ALLISON. (Communicated by M. D. Porter, United States.) Dated September 28th.

16,408. "Improvements in electric arc lamps." H. R. LOW and THE ART WORKSHOPS, LIMITED. Dated September 28th.

16,420. "Improvements in telephone transmitters and receivers." C. B. CALLOW. Dated September 28th.

16,431. "Improvements in means and apparatus for telegraphic purposes." A. MITCHELL. Dated September 28th.

16,451. "Improved system of electric train signalling for preventing railway collisions." W. P. THOMPSON. (Communicated by E. Espiau and P. Ferrer, Spain.) Dated September 28th. (*Complete.*)

16,456. "Improvements in electric switch apparatus or means for controlling electric circuits." A. G. BROOKES. (Communicated by J. P. Cushing, United States.) Dated September 29th. (*Complete.*)

16,487. "Obtaining a fluid for primary batteries and of recovering the effective matter from the spent fluid." H. H. LEIGH. (Communicated by J. B. Gardiner, United States.) Dated September 29th. (*Complete.*)

16,522. "Improvements in or relating to electrically soldering or brazing metal." W. P. THOMPSON. (Communicated by C. L. Coffin, United States.) Dated September 29th. (*Complete.*)

16,526. "Improvements in pencils or electrodes for electric arc lamps." H. H. LAKE. (Communicated by E. Tweedy, United States.) Dated September 29th. (*Complete.*)

16,530. "Improvements in and relating to receiving instruments or relays for submarine cable and other electric circuits." H. H. LAKE. (Communicated by C. G. Burke, United States.) Dated September 29th. (*Complete.*)

16,549. "Fuse for electric circuits." F. C. HELM. Dated September 29th.

16,551. "Improvements in and relating to transmitting instruments for submarine cable and other electric circuits." H. H. LAKE. (Communicated by C. G. Burke, United States.) Dated September 29th. (*Complete.*)

16,572. "Improvements in armatures for dynamo-electric machines and motors." W. B. SAYERS. Dated September 29th.

16,612. "An improved form of voltmeter." F. H. NALDER, H. NALDER, C. W. S. CRAWLEY, and A. SOAMES. Dated September 30th.

16,641. "An improved coupling for lightning conductors." J. LEWIS. Dated September 30th.

16,657. "Improvements in gas outlet valves or plugs for electric battery cells or other like vessels." W. MOSCROP. Dated October 1st.

16,667. "Improvements in the method of and means for manufacturing nickel tubes, rods and other bodies by electrical deposition." H. WILLIAMS and W. HEPWORTH-COLLINS. Dated October 1st.

16,680. "An improved electrical switch." W. H. BLAKENEY. Dated October 1st.

16,752. "An improved electrical and mechanical alarm clock." D. J. MULLARKY. Dated October 2nd.

16,767. "Improvements in apparatus for electric cooking and heating." F. W. S. JENNY. Dated October 2nd.

16,866. "A new or improved method of and means for the electrical propulsion of missiles." A. G. MELHUISH. Dated October 3rd. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

10,183. "Improvements in electrical switches and fixtures connected therewith." H. H. LAKE. (Communicated from abroad by S. Bergmann, of New York.) Dated July 1st. 8d. Consists chiefly in improvements in fixtures having seats for electrical switches, the switches and devices immediately connected therewith. The seat consists essentially of outwardly curved portions formed in the tube itself, or with said curved portions having sockets at opposite sides to engage ends of a tubular portion of a fixture through which electric wires may pass. The outwardly curved portions have depressions at the ends, so that binding screws on a switch may be more readily reached, and they also have on their inner faces or surfaces transverse channels, in which the frame of the switch engages. 9 claims.

11,499. "Improvements in dynamo-electric machines." A. E. WADLEY. Dated July 23rd. 8d. Consists chiefly of an armature of a cylindrical or spherical shape, built up of iron discs suitably insulated from each other, and having iron cheeks or extension pieces protruding from its centre at one or both ends of the said armature along its axis of revolution in such a manner, that the said cheeks or extension pieces are capable of being brought into direct contact with, or close proximity to, the pole or poles of one sign of the field magnets hereafter to be described, and thereby communicate magnetism to the said armature. The body of this armature is wound with insulated wire in coils in a direction parallel to its axis, in order to induce electric currents therein, the above described cheeks or extension pieces being left bare for the purpose above described, viz., bringing them into contact with the pole or poles of one sign of the field magnets. 3 claims.

11,553. "Improvements in and connected with the electric propulsion of vehicles on railways and tramways." W. E. HEYS. (Communicated from abroad by Jean-Jacques Heilmann, of Paris.) Dated July 25th. 8d. The inventor replaces the locomotive of ordinary railways and tramways by a vehicle or vehicles on which there are mounted a fixed steam engine and boiler, a gas or petroleum engine, or a hot air or compressed air engine or other suitable prime mover. The steam engine or other motor is employed to drive a suitable dynamo or dynamos, which may be carried on the same vehicle as the motor by which it is driven. The electric current generated by the dynamos is conveyed by suitable conductors to each of the vehicles constituting the train, and upon each of which there is an electric motor, which motors are employed to rotate the axles or wheels of the carriage or waggon. 3 claims.

11,883. "Improvements in the distribution of electricity and in the apparatus employed therein." T. TOMLINSON. Dated July 29th. 11d. The inventor provides apparatus to be attached to groups of transformers at sub-stations or elsewhere for the purpose of disconnecting some of the transformers in each sub-station when the load on the secondary diminishes, and for replacing them as it increases. 8 claims.

13,853. "Improvements in the production of electricity and in means or apparatus therefor." C. A. FAURE. Dated September 3rd. 8d. Relates to batteries consisting of two carbon plates or electrodes, one of which is porous, and is covered with a layer of suitable material, for example canvas, and the other dense and non-porous, and covered with granulated or spongy iron, are immersed in a solution of sea or common salt, and a current of air, mixed with carbonic acid, is passed through the pores of the porous carbon plate or electrode so as to depolarise the same. Also relates to apparatus for generating the gas, &c. 6 claims.

9,275. "Improved methods or means of or apparatus for driving dynamos or electric generators." P H. WILLIAMS. Dated September 8th. 4d. Relates to arranging dynamos or electric generators in the interior of or attached to water wheels in such a way that it shall be connected to and be driven by the water wheel, and require only connecting apparatus to transmit the electricity. 2 claims.

9,411. "An improved form of telephone plug whereby the strain is taken entirely off the metallic connection." C. P. J. FITZSIMON. Dated June 18th. 6d. Consists of a cylinder of metal or other suitable substance covered with insulating material, and terminating at one end with a cover in which is a hole for the cord or other connection to pass through. The inside of the other end has a thread to which any form of plug may be screwed, and there is at this end a small hole through the insulating material in which a binding screw is fixed that secures the plug to the cylinder and prevents its turning round.

10,187. "Improvements in or appertaining to self-exciting electric generators." W. P. THOMPSON. (A communication from abroad by W. Stanley, jun., and O. B. Shallenberger, both of America.) Dated July 1st. 8d. In one form of the invention, the armature of the dynamo-electric machine is wound with two independent coils, or sets of coils, one of which supplies current to the work circuit, while the other has its terminals connected to the field magnet coils for the purpose of exciting the same. This second coil is placed at an angle to the first, and is affected by a third coil lying adjacent to it, or in such a manner that any variation in the amount of current flowing through the third coil will cause a corresponding variation in the number of effective lines of force threading the second coil, and thus vary the field strength. This third coil is connected in series with the first coil. 3 claims.

12,352. "An electric contact maker for ringing electric bells and for other purposes." A. H. BAGNOLD. Dated August 7th. 6d. A metallic ring or a plate perforated with a circular hole is attached to an insulating base. Through the centre of this ring and at right angles to the plane of the ring passes a metallic rod fastened at one end to the before-mentioned base. The rod is kept normally in its place in the centre of the ring either by its own rigidity, by suitable springs and fastenings, or by the force of gravity, in which last case its fastening to the insulated base is of the nature of a suspension. The conductors are connected respectively to the rod and to the ring. Contact is made by deflecting the rod until it touches the ring. The contact-maker acts both as a push and as a pull. 1 claim.

ELECTRICAL CITY TRAM-LINES IN BERLIN.

[FROM OUR OWN CORRESPONDENT.]

Siemens and Halske's Project.

FOR a considerable time the question of improved communications in the German capital has been more and more coming to the front, especially since the population is approaching the second million. Some time ago the firm above mentioned submitted a project for urban electric lines to the municipal authorities, but a report was circulated that they objected, on principle, to elevated lines, which, it would seem, are the sole kind practicable in Berlin. This report is an error, since both the municipality and the Minister of the Interior have given their general consent, though the question of details is still under consideration.

The fact that the present means of communication in Berlin are insufficient is at once conceded. The so-called "city line," which is useful only to those parts which lie to the north of the Leipziger-strasse, has reached the limit of

its capacity. Any increase of the tramcars in the centre of the city is conceivable only if electric power is brought into play instead of horses. But even this would be a very imperfect remedy. The only resource is the construction of new urban lines which shall not interfere with the traffic in the streets.

The projected lines cannot be underground like those of London, on account of the high water level and the system of sewerage, but must be elevated. They cannot be planned as gigantic structures for heavy trains drawn by locomotives.

The new lines are to be in their structure and working similar to the "elevated railroads" of New York. They are to be of normal gauge, and constructed merely to bear the weight of carriages, but not of locomotives.

The traffic will not be effected by long trains at intervals of 10 minutes as on the existing urban lines, but by single electric carriages supplied with current from a central station, and succeeding each other at intervals of two to three minutes. They will, however, admit of being coupled in groups of 2—4. If the carriages or trains follow each other at intervals of three minutes, each carriage conveying only 40 passengers, the yearly traffic on working 18 hours daily will amount to 10½ million persons. If the interval is reduced to two minutes, the yearly number of possible passengers will reach 15¾ millions, and if double carriages or short trains of 3—4 carriages are used the capability of the line will reach to twice or four times the above numbers.

The estimated cost, inclusive of stations, &c., is 1½ million marks per kilometre run.

Siemens and Halske propose at present merely the construction of one line, the South line, which will consist of a number of portions not intelligible without a plan of Berlin. The cost of the line will reach a total of 84 million marks. The south line, taken singly, will measure 8·9 kilometres in length, and will cost 13½ million marks.

The stations will be arranged at points where the traffic is most dense, *i.e.*, at the intersections of the main streets, and at the bridges over the canal. At each end of the line there will be a main station where carriages may be transferred from one track to the other, where they may be left overnight, and undergo any needful repairs.

The tracks will resemble in general those of the elevated railways of New York. As they are to be constructed with turn-tables they may be longer than those of the existing urban line. They are to be made in seven compartments, holding 52 persons. American carriages cannot be used, as they cannot be emptied quickly enough at the stations.

The distance between the tracks is 3 metres, so that the minimum width of the permanent way will be 2·2 × 3 = 5·2 metres. Including the paths, 0·8 metres in width on each side outside the line, the total breadth will be 6·8 metres. Between any two carriages passing each other there remains —as the carriages have no steps—a free space of 0·8 metre.

The distance between the two tracks is such that passengers leaning out of the window cannot be injured, and that in case of need a workman may stand in safety between two carriages passing or meeting each other. The carriage doors are only 0·6 metre in breadth, so that a door left standing open cannot occasion any injury to the carriages on the opposite track. The carriage doors on the side turned away from the platform will also be kept locked, as they are on the London Metropolitan Railway.

The stations are arranged as simply as possible. There is no entrance hall, waiting room, w.c., and booking office. They consist merely of the stairs and the platforms, which, like the rails, are covered with a light roof. The platform is not, as in the urban line, between the two tracks, but on the outside of each, thus keeping the traffic in each direction apart. The platforms are equal in length to three carriages. The tickets are supplied by an official who stands in an appendage to the entrance stairs. They are not stamped, but simply taken from a packet, as it is done in tramcars. An official at the exit stairs takes the tickets from the passengers as they leave.

The platform is three metres in breadth. To prevent damage to persons waiting, by the doors being opened too soon, the doors of all the compartments are kept bolted until the carriage has come to a stand, when the bolts are simultaneously released by the conductor. The step from the platform into the carriage is only 0·32 metre.

CORRESPONDENCE.

Telephoning of Great Cities.

I had hoped that the task of replying seriously to Mr. H. Goodwin would not be forced upon me; but he has mistaken forbearance for fear, and has returned to the charge with so much assurance and appearance of self-gratulation that I shall waive my natural impulse to refrain from hitting such a very obvious "little 'un," and deal with his statements on their merits. This is the more necessary as I understand from a remark in your editorial of October 2nd that you consider he raised points of practical importance.

Mr. Goodwin is under the impression that he indicated in his first letter certain defects in my proposed system. I cannot find that he did so. He certainly referred to defects which he supposed to exist, but his suppositions were the consequences of lack of knowledge of what had been going on for years outside the circumscribed area of his own observation. There are many lads receiving salaries ranging from £39 to £52 a year in the National Telephone Company's service in Scotland and elsewhere who could dispose of Mr. Goodwin's objections in a few minutes, were the opportunity afforded them, simply because the everyday experience of their lives teaches them that such objections are based on imagination only.

Goodwin's sneer about "our only telephonist" is absurd. I have never posed, nor dreamed of posing, as such. The complimentary references I made to other telephonists in my B.A. paper, and in my letter of September 24th, is sufficient to disprove that, if, in the estimation of my friends, it needs any disproof, which I doubt. On the contrary, I seize the opportunity to state that, in my opinion, there are at least as many able telephonists in Great Britain as in America or elsewhere. Some of these are in the employ of the National Company, where, however, owing to the peculiar conditions of service which obtain, they have absolutely no scope for their abilities.

Goodwin says that "there are in this country those who have (have had ?) as much experience as himself, who joined the telephone companies soon after the system was introduced into England, and *whom had had* (*sic*) previously a long and varied electrical experience." So far as I follow this, I am inclined to concur. As Mr. Goodwin is the only hostile critic who has signed his name (the other adverse criticism being anonymous), I infer two things; firstly, that Mr. Goodwin is himself one of those "whom had had;" secondly, that all the other whom-had-had's approve of my paper. If the first inference be correct, the amount of intellectual activity displayed by Mr. Goodwin during all these, his long years of experience, cannot have been very great, since, familiar as I am with matters telephonic, I never heard his name before, nor can I find any telephonist who has been more fortunate. The list of the Institution of Electrical Engineers knows it not, and the archives of the Patent Office and the electrical directories ignore it; so that I am afraid that Goodwin had been burying his talents very successfully from the vulgar gaze, until some evil spirit impelled him to betake himself to criticism. His letter must have come to his friends, even more than to me, as a bolt from the blue—or green.

Goodwin goes on: "Anyone acquainted with the subject may be apt to draw *similarity* between smokeless powder and Mr. Bennett's telephone scheme, with the conclusion that the former was smokeless but had good effect, the latter being all smoke without effect." Shade of Lindley Murray, what a sentence! Apart from the grammatical errors, Goodwin commits the additional one of confounding a *similarity* with a *contrast!* Poor Goodwin!

After this, I accept frankly and without reserve the assurance you gave me on October 2nd, and which Goodwin kindly confirms, *that the columns of the* ELECTRICAL REVIEW *are not those of the Times.*

Goodwin objects to the meaning I attached to his statement that "up to the present no one (to my knowledge) had any experience of metallic circuits on a large scale, which I reiterate." Standing alone, this did not appear to have any bearing on the discussion at all, being a bold statement of what Mr. Goodwin considered a fact, but which, of course, was nothing of the kind; and I inferred that he meant that although the efficacy of metallic circuits had been proved on a small scale, there was reason to doubt their success on a large scale. If this is not the meaning, then the sentence is

altogether a foolish one, and your valuable space has been wantonly wasted. But, meaning or no meaning, the statement is wrong. The Post Office has had a good many years' experience of metallic circuits on a large scale in Northumberland and South Wales. When I visited Newcastle three years ago, there were over 600 metallic circuits working in that town alone. The Paris Exchange has been worked with metallic circuits from its initiation in 1879. On December 10th, 1885, there were 4,054 metallic circuits at work (*Dr. Rothen, Etude sur la Téléphonie, Berne*, 1888), and, at present, I understand that the number is well over 6,000. The Mutual Telephone Company has, at the date of writing, 631 metallic circuits actually speaking in Manchester and 400 more on the verge of completion. And yet Goodwin, who ought, as a telephonist of common information, let alone as an expert, to have known at least all about Northumberland and Paris, calmly tells your readers that nobody has had any experience of metallic circuits on a large scale! If, as is evident, he was not even acquainted with the bare fact that metallic circuits are used in Northumberland and Paris, what must be the state of his knowledge respecting the instruments and switching systems employed in connection with those exchanges?

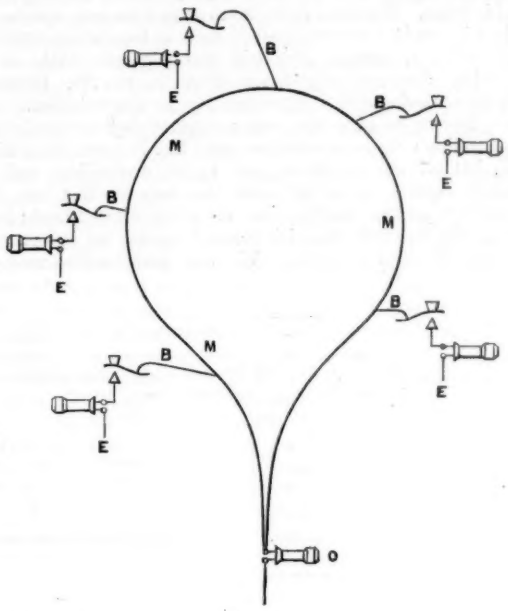
At his next step Goodwin exposes his ignorance further. He persists in assuming the Law and the Mann systems to be identical, thereby rashly flying in the face of the Electrical Review itself, which has admitted a difference, although it has failed to grasp the immense practical importance of that difference. He says, referring to the Indian exchanges, "The system I mentioned as having been changed to the magneto-annunciator system *was identical* with the one proposed by him—metallic circuits alone excepted—and was known to us as the Law system, whether it was the *real* Law, Mann, or anybody else's system I do not pretend to say, but I can assure him it was a call wire system, and I am satisfied that it was worked on similar lines to those he lays down and was found to be inefficient." How can one deal seriously with a man like this? He was there, in India, on the spot, and presumably made himself acquainted with the system in use, and yet with the differences between the Law and the Mann so clearly defined as they have been in Preece and Maier's book; in *Engineering*, and elsewhere, this admirable critic is unable to say whether the system that was superseded was the Law or the Mann; and yet ventures to assert that it was the same as the one I recommend! Of course, I have stated that I do not propose to employ the Law system, and that I have no confidence whatever in it. I happen to know that the switching system first used in India was the Law, pure and simple, but I also know that the construction work throughout was originally so thoroughly bad that it would be unfair to charge the failure of the Indian Exchanges on that system. About 1883 I was consulted by a firm then supplying material to the Indian Exchanges, and I understood from them that the original construction work had been very bad. I was shown a report from one of the Indian engineers (could it have been M. Goodwin?) to the effect that sand lodged in the insulators and caused induction!

Mr. Goodwin's next paragraph again reveals his simplicity. In his first letter he said that a break in the service wire (the Law system idea dominating his noddle) has the effect of cutting off all the subscribers from the Exchange. I assured him that it was not so, and he now, with infinite sarcasm, challenges me to prove my words, designating as a "miraculous cure" a simple device about which any of the 15s.-a-week lads I have mentioned could enlighten him. It is shown in the figure.

It is clear that *one* break anywhere on the line will not cut off even a single subscriber. Two *simultaneous* breaks must occur before any subscriber can be interfered with, and these must happen on the first spans from the Exchange, a position in which faults can be most readily found and remedied, before all can be affected. As a matter of experience, I can say that the cutting off of subscribers does not occur in practice. This "miracle" was not a part of the original Mann plan, but is an improvement due to Mr. J. D. Miller, my late able assistant at Dundee.

With reference to my being copied in London. The fact is notorious, and I shall not give any proofs at the bidding of a man of Goodwin's calibre. Let somebody of better standing, say Leyland or Colonel Jackson, dispute it, and ample proof shall be forthcoming, I promise.

Goodwin says that he used a similar system in India in 1883-4, and believed it to be American. The first part of the statement may possibly be true, since the firm I have referred to sent plant of my design to India, the Cape and South America in the years named—that Goodwin thought it was American was a consequence of his own ignorance.



M, Main service wire; B, Subscribers' branches; O, Operator's phone.

A telephone expert ought to know that in the United States only wooden standards for overhouse work are used. I had the pleasure of meeting Mr. Thos. D. Lockwood in Scotland in 1889. He specially noticed the overhouse construction he saw there, and said they had nothing comparable to it in the United States, where wood was universally employed for roof work.

Goodwin, in concluding, offers to meet me when I consent to "argue electrically." I've got a notion that he will now repent him of his offer, whatever it may mean, and that he will, as others have done, arrive at the opinion that "discretion is the better part of valour." No doubt he will think that I have dealt in quibbles, verbal straws, and assertive self-praise, and have avoided the main points at issue—that is only natural on the losing side—but still, unless I am much mistaken, he will remember the distich,

> "He who fights and runs away
> May live to fight another day,"

and be discreet.

I don't propose to say much about your editorial note to my last letter. A more favourable outcome of the veiled personal attack which you permitted yourself (I sincerely believe in the best of faith and without any ulterior design), to be made a party to, I could scarcely wish for. I think I have said enough to re-consign to their resting place the shovelful of discredited crudities, culled from Mrs. Morgan Malaprop's telephonic dust-bin, that were allowed to pass as adequate criticisms on my paper. Only this I will add, if you really opine that I have avoided discussion I invite you to put in a series of concise paragraphs, numbered 1, 2, 3, &c., the points you desire elucidated. I will then answer them seriatim and number my replies to correspond. My difficulty at present lies not in replying but in understanding what I am expected to reply to. We appear to have studied English in different schools, your critic and I; but, perhaps, if he follows the plan I suggest, we may get on better in future. Only let us have something more to the point than the trash evolved by this poor simple fellow, Goodwin.

A. R. Bennett.

October 13th, 1891.

[Mr. Bennett asked our permission to reply to Mr. Goodwin's letter which appeared in our last issue. Such

permission we gladly gave. In due course we received the above effusion, which, in the disguise of a reply to Mr. Goodwin, does nothing but abuse that gentleman, some others, and ourselves. It is our unfortunate duty to criticise, and we are accustomed to be abused in consequence. We are not sparing in the facilities we accord our aggrieved correspondents for saying hard things about us in our own columns, but a responsibility rests on us when such language is used to others as Mr. Bennett has employed in his letter. We must apologise to those who may reasonably join with us in a protest against such a use being made of our columns, though they will probably agree with us in thinking that the only harm done is to Mr. Bennett. We have carried our forbearance far in our criticisms and have desired to give him every opportunity for reply and explanation; we have tried to save Mr. Bennett from himself, but all our efforts appear to be unavailing, and we cannot repress a feeling akin to sadness that so fine a subject as the telephoning of great cities should have given rise to such exhibitions of littleness as is apparent in Mr. Bennett's letters. We can make allowances for irritability under criticism. That ours was accurate and timely has been amply shown; if it needed any justification Mr. Bennett's letters supply it.—EDS. ELEC. REV.]

Would you kindly afford me space for some remarks on this interesting subject?

The discussion which followed Mr. Preece's paper at Frankfort is not given in your columns, but it is noted that Mr. Bennett took part. It would be of interest to know whether he took any exception to Mr. Preece's statement "that we are ashamed of the telephone in England." Perchance Mr. Preece was understood to use the word "England" in the same sense as the Rev. David Macrae insists upon, viz., as not including Scotland.

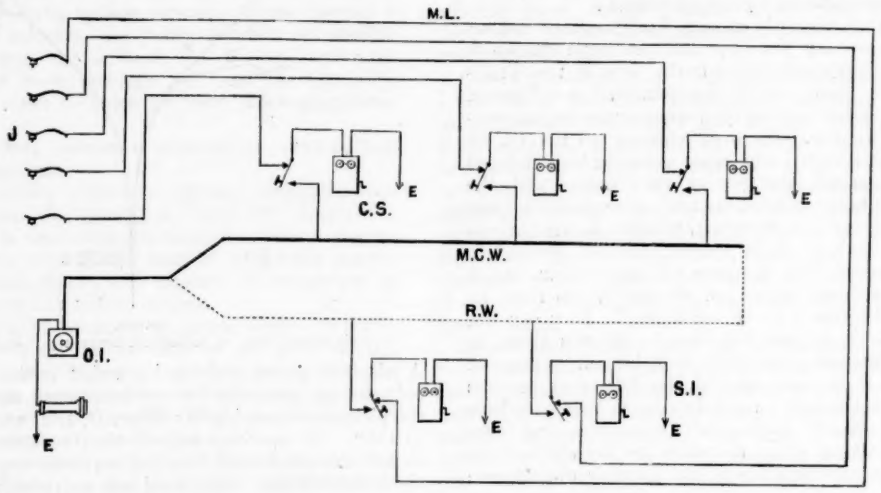
In Mr. Bennett's paper he speaks of 60 to 100 subscribers to each operator's call wire, but that number is too great, even in Dundee. The pressure, of course, varies at different hours of the day, but that can be provided for.

It is not only desirable, but necessary, to "tap;" it has to be done at times where the call wire is in use, and there is no serious objection or difficulty in its performance.

In *Engineering* of March 25th, 1887, if I am not mistaken, it is Mr. Bennett who describes the Mann plan as "a modification of the 'Law' system of switching." In his letter of September 24th, he says: "Certainly it (the Mann) was in practical use in Great Britain before the Law." So far as I have been able to trace, the Mann call wire was introduced experimentally on a portion of the Dundee Exchange about July, 1882. The light hearted and evanescent Yankee managers came to Glasgow on February 26th, 1881, and brought Law call wire instruments with them, and so far as my recollection serves, they had previously introduced this system in Yorkshire. I made a sketch from a Law instrument at Glasgow on April 2nd, 1881, and revised in June, 1881, a list of the subscribers who were to be put on the Law system, and they were put on. Mr. Bennett went to Glasgow in January, 1881, so that he could, probably, on referring, say when the Law call wire was actually erected. If Mr. Mann devised his plan without any knowledge of the Law, he should say so. Whether or no, there can be no question of its superior merits, nor of the credit to which he is justly entitled in either case. The objection raised to the call wire as to hearing the numbers asked for by subscribers on the same call wire is of no moment, and has never caused complaint in my experience.

In replying to Mr. Goodwin, Mr. Bennett says he does without the service wire. I presume he means call wire *spurs*, as from his paper, I think he requires a call (or service) wire or wires to each cable of 36 or 72 metallic circuits.

So far as I can see, if Mr. Bennett's electrostatic induction call wire, as described in his paper, should break, the subscribers beyond the break must be cut off. But he assures Mr. Goodwin that he is mistaken in assuming that such is the case with call wires, but does not offer an explanation. Perhaps you will kindly permit me to state that such *was* the case at one time (and still *is*, it would appear, with Mr. Bennett's), but my plan of returning the *main* call wire to the exchange, as shown in the accompanying diagram, disposed of this objection to a considerable extent. A single break does not affect the service of the call wire at all, and with two breaks the subscribers between the breaks only are cut off. An earth of course affects the call wire according to its situation and resistance.



M L, Main lines; J, Jacks; C S, Call spurs; M C W, Main call wires; R W, Return wire; O I, Operator's instrument; S I, Subscriber's instrument.

It occurred to me to try this early in 1887; the first board with the *returned* call wire was joined up at Dundee, with Mr. Bennett's approval, in November, 1888, and is still working. As a consequence of the extra security afforded by this improvement, indicators on main lines have been dispensed with in tables since made.

Mr. Bennett recognised the value of the improvement by adopting it at Aberdeen, and dispensing with indicators, when the call wire superseded the old system there, in September, 1890. He provided, it may be noted, a breakdown board with indicators against the possibility of a collapse of a call wire.

The economy of first cost, maintenance and space in dispensing with indicators is obvious. By the last, each operator is enabled to reach a much larger number of subscribers.

I can agree with Mr. Bennett—so far as my knowledge goes—that the remark in your criticism as to the numbers of exchanges abandoning the call wires is an error. On the contrary, with my improvement, it has for some time been in course of erection at one of the National Company's exchanges in London, and I am credibly informed is about to

be introduced—without indicators and with returned main call wire—at one of the largest provincial exchanges.

In my experience of Mr. Bennett he always gave credit where credit was due, and no doubt he will now acknowledge my claim to an improvement which he considered of no little importance.

With reference to Mr. Bennett's new plan, it appears to me very probable that there will be overhearing between the call wires. At present, with overhead wires, it is possible to overhear between two single wires which run parallel for some distance respectively at each end of a metallic circuit of some length; and, apparently, the electrostatic conditions to which this is attributed will frequently be reproduced in Mr. Bennett's system. In the same way, referring to Mr. Bennett's diagram 5, if I am not mistaken, it might be possible for all that takes place on the call wire of the first switch-room to be overheard on the call wire of the third switch-room and *vice versâ*, which of course would never do.

Would Mr. Bennett mind stating whether his E.S.I. call wire has had an extensive trial in Manchester, and whether the returned main call wires have in fact been superseded there?

With two exchanges having trunk communication and no call wire it would always be an advantage, and not a disadvantage, for one of them to have the call wire, but better still, of course, if both were to adopt it. In this I am in accord with Mr. Bennett. I am justified in assuming that the tests given in Mr. Bennett's appendix were those made by me in Dundee so long ago as November, 1888. But Mr. Bennett has made a serious slip in applying them. The figures given in test B, it is only right to point out, were *not* those in which the connections had to be handled by three operators, but they are those which were handled by one only.

Mr. Bennett gives the dimensions for 100 jacks on the Mutual board as 5¼ inches square, equal to an area of, say, 27·562 square inches. The space occupied by 100 of the smaller pattern Western Company's multiple jacks is, say, 11·5 by 3·5 inches, equal to 40·25 square inches. A saving of space would thus appear to be effected by the Mutual, but whether this gain is at the sacrifice of convenience in working and durability may be open to question. He gives 104·7 square feet as the space occupied by a Mutual board for 5,000 subscribers. Of course, this is not taken from an actual board without any allowance for the necessary multiple sections and junction, &c., jacks; I make this, on his own figures, for 5,000 *jacks* alone 114·843 square feet, and for the same number W.E. 167·708 square feet. He apprehends no difficulty in arranging 40,000 lines in one room. For that number of *jacks* alone, without allowance for multiple sections, &c., a space of 30·310 by 30·310 feet, or 918·75 square feet of floor space would be required for the Mutual, and 36·628 by 36·628 feet, or 1,341·6 square feet, for the Western Electric jack.

The ideal of the multiple system is that each operator should be enabled to reach any subscriber. How could this, or anything like it, be accomplished in such circumstances? How does Mr. Bennett apprehend he will get over this difficulty?

The greater part of the difference in Mr. Bennett's comparison with the Western Electric is due to main line indicators being dispensed with in his case, and the credit of first doing so successfully is not, if I may be pardoned saying so, due to the Law, Mann, Bennett, or Mutual.

For large exchanges, the economy of space effected by abolishing main line indicators and using horizontal boards is, of course, very important, but condensation of switchboards has its practical limits, for if each operator can only attend to, say, 50 subscribers on her call wire (and similarly, say, 50 indicators on a non-call wire system), then for 5,000 subscribers 100 operators, and for 40,000 subscribers at least 800 operators require to be seated at one and the same time. The switchboard, therefore, must not be so condensed as to prevent the requisite number of operators getting access to it.

Mr. Bennett says in his paper that the fulfilment of the indispensable conditions for an effective and popular exchange in a large town is easy if the undertakers are in possession of the right to open the streets of the towns and lay their conductors in the same way as gas, water and electric light conductors are laid. I would point out that in the case of gas, water and electric conductors you can lay a main of sufficient section to meet what may be considered the ultimate limit of the requirements of the district or route, and once that main is down it is easy to take branches from it as required, but with telephone conductors the case is very different. The two conductors of each metallic circuit are not merely branches from the main, but must go all the way to the exchange. What this means in difficulties of estimating what should be laid down for what distance along a route, spare wires, sections not required, faults, renewals and adding new wires can be conjectured.

A mixed system would appear meantime to be the best solution. Underground for junctions and main routes and overhead for distribution. In such a system the existing wayleaves of the National would be of much importance.

Whether exchanges should be condensed or not is very much a question of local circumstances, and the careful weighing of the *pros* and *cons* for each individual town. Concentration is good in many points—avoiding junctions, better control, saving operating and night operating and rents—and is facilitated by underground wires. With overhead wires, after a certain point, the number of wires to be dealt with prevents concentration, but there is another objection to concentration, viz., the practical limit referred to above.

Telephonists long ago imagined that a combination of metallic circuits, the multiple board and the Mann call wire, would give perfection, and there is therefore no novelty in Mr. Bennett's proposal on that point. At the same time, when carefully considered, difficulties and imperfections of no little magnitude can still be discovered in any such combination at present known or conceived.

If we take from Mr. Bennett's proposals all that is already used or known, what remains that is new in his plan? A small economy of switchboard space, which may actually be disadvantageous, and his electrostatic induction call wire, which would appear to be open to serious objections.

The British Association meeting was not, I respectfully submit, the place for such a paper as Mr. Bennett's. The Institute of Electrical Engineers or your columns would have afforded a better opportunity for immediate and experienced discussion, criticism and correction, but the different end which Mr. Bennett would appear to have in view has no doubt been served. The vigour with which he has pursued that end justifies the assumption that he has adopted the motto of a family of name—"Bene tenax."

I quite agree with Mr. Bennett as to the vastly better service afforded by the wire call system, but I cannot agree that he has yet solved the problem of telephoning great cities.

Jno. D. Miller.

October 9th, 1891.

[Mr. Miller differs from our conclusions on two points, and upon these it is desirable we should briefly comment. We cannot do so without first thanking Mr. Miller for his very interesting letter, and expressing our satisfaction at the welcome contrast between it and the other prominent letters on the same subject, in that it gives us facts and figures, and deals with them in a spirit of fairness. We think that further consideration will show some disadvantages in the intercommunication between exchanges employing different systems, and especially so for disconnections from many exchanges; but we have no desire to enlarge upon them. We merely refer to this in order to state that our original contention on this point was justified, though we think Mr. Miller's expression of opinion that it is not serious is entitled to much consideration. As to the abandonment of the call-wire system, we took, of course, a wider range than Great Britain affords. Mr. Goodwin's first letter gave one instance in Asia. We are not sure about Africa, but the other continents can certainly furnish instances too. Those continuing to exist in Great Britain are neither sufficiently numerous nor sufficiently extensive to modify the conclusion we expressed, viz., that in proposing a call-wire system Mr. Bennett was proposing a system which was older than any other system, the advantages of which were known, but the use of which had, nevertheless, not only not continued to increase, but had been abandoned in many cases where it had once existed. Mr. Bennett agreed that it was so with the Law, but not with the Mann. All these definitions of different systems fully justify the classifi-

cation we adopted in the first instance of "a circuit wire system." The assumption of those who take a different view to that which we expressed is that any abandonment which has taken place has been due to the absence of some feature in the construction of the circuit wire itself. Amongst the instances of abandonment is, we believe, the original Law exchange. We write with some reserve, but we also believe that the improved circuit wire plan described by Mr. Miller was in use at that exchange. It is very desirable that our remarks on the subject should not be interpreted as antagonistic to the circuit wire system which we know to be believed in by a minority with the fervency which minorities will believe. The advantages and disadvantages are probably much too deeply rooted to be fully set out in our columns. But in commenting on a newly devised plan employing the circuit wire system it is natural and inevitable to ask how it is that, with all the advantages of a circuit system, and all the disadvantages of a signal system, well and fully known, the world at large has adopted the disadvantageous method and abandoned the advantageous one? We cannot pretend to express a definite opinion. We can only suggest a spirit of enquiry, and in the absence of proof to the contrary, assume that experience teaches and the fittest survives.—EDS. ELEC. REV.].

Electrical Formulæ.

The two following formulæ occur in text books :—

(1.) "Two small circular coils at a great distance apart, of radii, r, r', carry currents, C, C'. Their planes being at right angles to each other.

The moment of the couple acting between them $= \frac{A\,C \times A'\,C'}{d^3}$

The action at a considerable distance of a small circular current is the same as that of a small magnet, whose axis is perpendicular to the plane of the current, and whose moment $= A''\,C$. Now the moment under similar conditions of two small magnets $= \frac{2\,M\,M'}{d^3}$ or $\frac{2\,A\,C \times A'\,C'}{d^3}$." Where is this wrong?

(2.) "The mutual potential of two circuits is :—

$$-\,i\,i' \iint \frac{\cos\varepsilon}{r}\,ds\,ds'."$$

How is this integrated in a practical case when the dimensions are given to calculate the mutual potential, and force of attraction or repulsion?

Potential.

Coefficient of Temperature of Alloys.

In your issue of the 25th September I saw a report of a paper read by Dr. Feussner at the Frankfort Congress on a new alloy of nickel and copper, comparing the variation of resistance to temperature, he finding that the coefficient of temperature varies in a regular manner according to the composition of the alloy.

The fact that very little can be found either in books or reviews concerning the coefficient of temperature of alloys, makes me think that it would be interesting to your readers if I give some results of experiments made by my father, M. E. A. Jacquin, inspector of French telegraphs in collaboration with M. Lagarde, engineer in the same office, and published by the latter in the review, *Annales Telegraphiques*, in the years 1888 and 1889. I append a brief *résumé* :

Bronze of high conductivity was tested against pure copper wire, it shewing approximately the same conductivity.

Bronze wire containing 1 to 2 of tin when the conductivity decreased to one third of the copper.

It was found that the alloy which had the highest resistance was the least subject to variations through difference of temperature. It was also found that, near enough for practical purposes, the coefficient of temperature varies directly as the conductivity of the wire, hence the product of multiplying the coefficient of temperature into the specific resistance is a constant number.

Other experiments with alloys of coppers with small quantities of magnesium have proved the same rule and given very approximately the same number as the product of the coefficient of temperature into the specific resistance; experiments have not been made with other alloys having a copper base, but if made most likely the result would be found the same.

It is a very important question in telegraphy and telephony to know the resistance of a wire at various temperatures; but whilst the resistance or conductivity of a wire is easily measured, the measurement of the coefficient of temperature is a delicate operation. The following rule found by experience gives a convenient means of finding by calculation the coefficient of temperature of any bronze or copper and magnesium wire (these being most employed in telephonic lines) with sufficient accuracy for practice; even for other wires having a copper base the result would probably be not far from the truth.

The resistance of a certain length of wire is taken and multiplied into 0·00422 (coefficient of temperature of pure copper) and divided by the resistance of a pure copper wire at the same temperature as the wire being tested, which is given in all handbooks. Other experiments made with homogeneous iron, galvanised iron and steel, have shown that the same rule holds good for ferrous substances, although not with the same degree of accuracy; however, for a rough approximation the following rule may be used :—

Measure the resistance of any iron or steel wire used in telegraphy, and multiply it into 0·00434, divide by the resistance found in the tables for homogeneous iron wire at the same temperature; this will give the coefficient of temperature for any ferrous material.

Hoping that the above will prove interesting to your readers.

Ch. Jacquin.

October 12th, 1891.

Electropathic Nostrums.

May I, as a constant and appreciative reader of your Journal, bring to your notice a new, and, I seriously believe, hitherto untrodden path in the vast fields of electrical science.

"The Electric Charged Pill," a full and most interesting description of which I beg to enclose you, at once deals a death blow at all the belts, brushes, combs, hair curlers, &c., hitherto relied upon by a too credulous and eminently indigestible and bald public, and stands revealed in all its potent majesty at 1s. 1½d. per box. Patent pills of the usual monotonous type have undoubtedly a "positive" action, as most sufferers are aware, whereas the Electric Charged Pill Company's appalling discovery rather suggests a hidden "negative," as well as a "positive" result when taken "for all the ills that flesh, &c." There is no possible, probable, shadow of doubt about the future generations being regulated both internally and externally by electrical (?) quacks; but I should very much doubt if even in years to come it would be ever asked to swallow a much bigger pill than is here offered by the scientific devotees of the pestle and mortar. I am now busily engaged in connecting up 100 pills in series, in the hope of being able to further illuminate the social darkness in which I have hitherto sat, when so many of my fellow creatures are devoting their lives to the good of others at 1s. 1½d. per box.

The law is too busily engaged at present, I fear, to explore the hidden mysteries of electrical science; but when it does make a move, it will be in a much needed direction.

Lyndhurst.

October 13th, 1891.

Insects in Electric Meters.—It has been a difficult matter up to the present to provide against insects in meters, which, of course, are generally slightly warm, and attract young beetles and other insects. According to a speaker at the recent Electrical Congress at Montreal, however, the 'cute American customer is in the habit of levering his meter open, and introducing spiders, and special precautions are now taken so that any attempt of the sort produces a short circuit, which remains as evidence of the attempted fraud.